OCTOBER 1957

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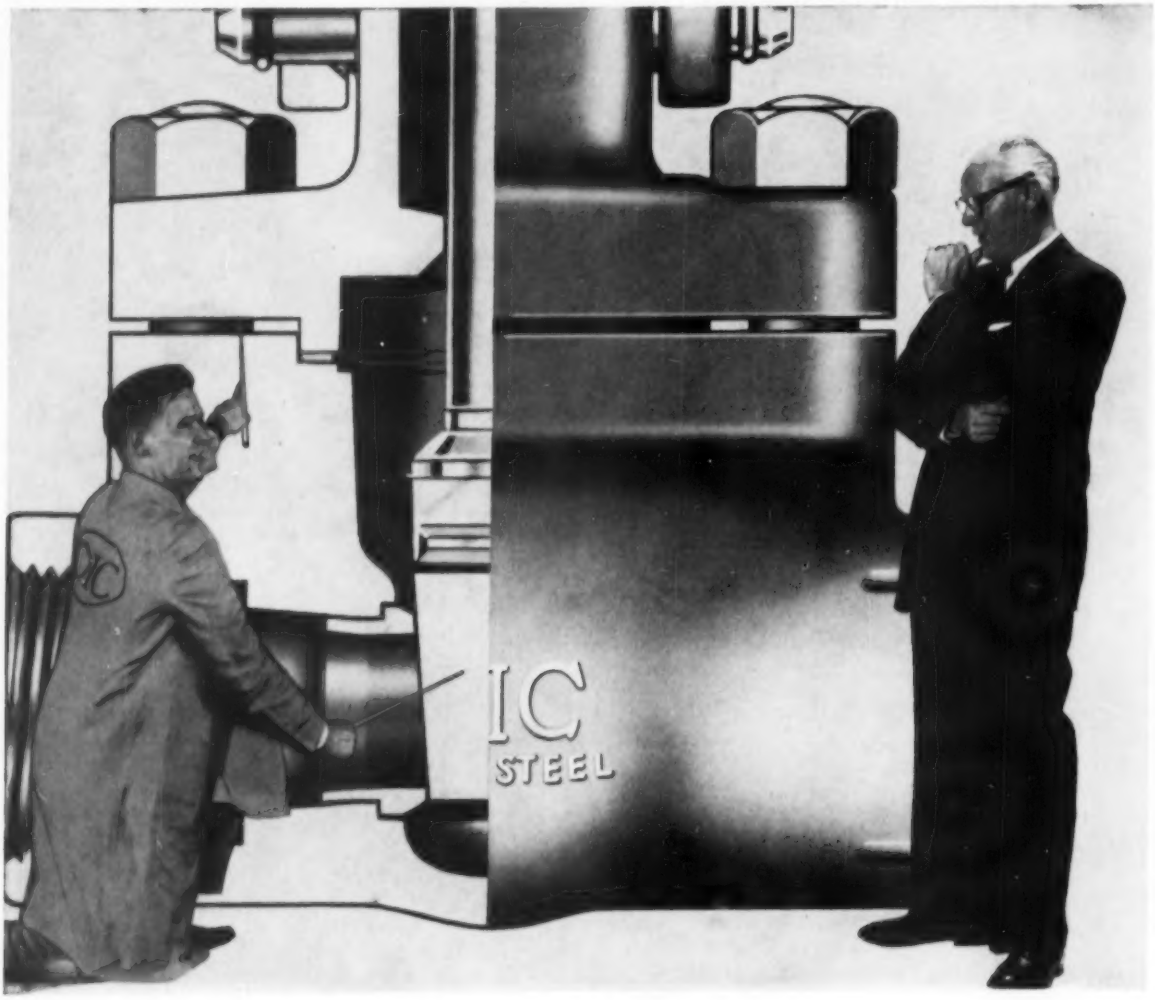
...and you can see here....and here, sir, how we've killed maintenance problems on our new forged steel lines.



We stop galling and erosion by giving you 13% chrome stainless steel trim with wedges *duracased* to a rugged *1000 Brinell hardness*.

The square and *bolted* body-bonnet joint makes it easy to service the valve quicker. And it's a tighter joint, made doubly leakproof by recessing the soft iron gasket into the body. The gasket can't blow!

And you get the fastest joint make-up you've ever seen. Look at those pipe ends. See the extra wrench-gripping area and lugs. See how body-bonnet flanges are out of the wrench's way. No time lost here!

These new 600-lb. OIC forged steel valves are available with either *high-flow* ports (1300 line), or *standard-flow* ports (1100 line). Call your OIC Distributor, or write for specification literature.

The Ohio Injector Company • Wadsworth, Ohio

OIC VALVES | BRONZE, IRON, FORGED AND CAST STEEL, LUBRICATED PLUG VALVES

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ALL IN A DAY'S WORK at *Pittsburgh Piping*

These three jobs are typical of the wide variety of custom piping work which we do for the power and process industries. In the background of the photo welders are shown making the heli-arc root pass on 18" O.D., 3.875" wall, chrome-moly main steam piping. In the foreground, ready for final inspection, is a 12" header for a process operation, fabricated of ⅜" aluminum alloy. The pressure vessel, of austenitic steel, is one of many we produce for atomic energy application. The manufacturing of this type of piping requires specialized facilities . . . for engineering, fabricating, testing, assembly, and erection. We have those facilities. Use them on your piping jobs.

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PUBLISHED SINCE 1896 FOR POWER ENGINEERS IN PRIVATE AND PUBLIC UTILITIES AND INDUSTRIAL PLANTS

ENGINEERS' PREVIEW

NO EASY ANSWER awaits the ambitious young man today who asks, "How do I become a nuclear engineer?" But at least it is clear that the time has come when the major responsibility for nuclear engineering education must rest not with national laboratories but with the colleges and universities.

Such was the conclusion of the American Society for Engineering Education, which met recently at Cornell University for its 65th annual meeting. Three techniques were suggested for colleges and institutes of technology to use in rising to meet the need. One is to incorporate appropriate nuclear data and laboratory work into the usual undergraduate course in science and engineering. Another is to modify courses to make room for a connected study of nuclear energy; while the third technique is to develop new courses in nuclear energy and its applications. All have drawbacks but experiments with all three techniques must be considered, the conference urged.

Research manpower was another issue discussed by the conference. Gist of it: better salaries will overcome the present shortage of qualified research staff.

POWER FROM NIAGARA, developed to a full potential of 1,800,000 kw at firm capacity, will become a reality in the next three years. After seven years of discussion and controversy over ramifications of the project, Congress has passed a bill enabling the New York State Power Authority to build a $600,000,000 power plant at Niagara Falls, which will take advantage of nearly all of the 326-ft drop in the falls. Under a treaty agreement reached in 1950, Canada has long been taking advantage of her share of the Niagara power resource.

Congress has specified that 900,000 kw must be earmarked for withdrawal for use by public bodies (municipalities, coöperatives, defense plants). Private utility customers for the new power supply will include Niagara Mohawk Power Corp, New York State Electric & Gas Corp, and Rochester Gas and Electric Corp.

Design for the new station provides for an intake above the falls, which will divert water to the turbines and to a reservoir. This reservoir will fill at night, when the U. S.-Canada treaty permits a greater flow and when power demand is less. During the day, when demand is greater, the water will leave the reservoir, the pumps becoming generators to produce extra power.

TWO NEW BOOKLETS you ought to have are: Taxation for Growth, by J. Cameron Thompson, vice chairman of the Committee for Economic Development; and Advisory and Coördinating Mechanisms for Federal Research and Development, 1956–57. The Thompson essay is based on a statement on national tax reduction and tax reform policy, issued by CED'S research and policy committee. It may be obtained at 20 cents a copy from Alfred C. Neal, president, Committee for Economic Development, 444 Madison Ave, New York 22, N. Y.

The second booklet lists all agencies engaged in scientific research and development conducted by the Federal Government, and outlines the organization of each. It carries the imprint of the National Science Foundation, Washington 25, D. C., and is published by the U. S. Government Printing Office, Washington. Code number is NSF-13.

THE ELECTRICAL PAST and the preservation of its equipment and memorabilia is the very worthy objective of the Electrical Historical Foundation. On the board of the new group are such figures as Dr. Erich Hausmann, dean emeritus of the Brooklyn Polytechnic Institute; Dr. S. G. Hibben of the Holophane Corp; H. E. Kent of the Edison Electrical Institute; Julian K. Sprague, president of Sprague Electrical Co; E. S. Lincoln, consulting electrical engi-

neer; and Dr. Charles F. Wagner of the Westinghouse Electric Co.

Meeting the other day at the Burndy Library in Norwalk, Conn., the Foundation's board of trustees took steps to enlarge itself to be more broadly representative, established membership classifications. Sprague, Westinghouse and the Burndy Library became the first sustaining members, with $1,000 contributions. Contributing memberships are $100, with $10 or more for associate members.

A sizable amount of the Foundation's present funds was allocated to continue a program of locating and cataloging all historical electrical equipment on exhibit or in storage in museums, educational institutions, industrial plants and elsewhere.

KNOWING A THING OR TWO about the visual arts can help the engineer to develop his faculties of observation and intuitive judgment. So concludes a recent report on Art Education for Scientist and Engineer, issued by a committee to investigate the study of visual arts at MIT. The committee would like to see freshman and sophomore engineers taking courses that will correlate with other work in MIT's Humanities series. Programs for the junior and senior years might link art with engineering — for example, by studying the diverse interests of Leonardo, Wren, and modern industrial designers and architects.

In any case, the goal of an ideal program in art for the engineer is "to develop the capacity of the technician to undertake responsibility for the form that his technical training creates."

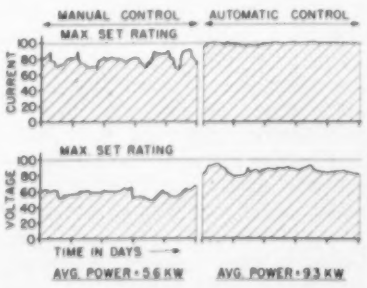
NO VISITORS, PLEASE. The much-publicized pressurized water reactor project at Shippingport, Penna., is now closed to visitors except for official groups. Construction of the plant has entered the final stages, and intricate component and systems' testing is underway on a round-the-clock basis, seven days a week. However, AEC and the Duquesne Light Co announce that the plant is expected to be open again to visitors from American and foreign industry after it has been placed in operation.

PACIFIC GAS & ELECTRIC CO has offered to take part in a joint development of the hydroelectric facilities of the Trinity River Project in California. This project is a Federal development through which water now running to waste into the sea will be diverted for reclamation purposes in California's water-hungry central valley. A by-product of the project will be the hydroelectric generation of 384,000 kw. Pacific Gas & Electric Co has offered to build the power facilities at no expense to the government, and to pay for the use of the falling water.

Over the 50-year project repayment period the government would gain $165,000,000 net from PG&E's payments for using the water. The company would also pay $145,000,000 in state, local and Federal taxes, making a total public benefit of $310,000,000.

FLUE GAS CLEANING by electrostatic precipitators is being built into the Bergen Generating Station now under construction at Ridgefield, N. J., by the Public Service Electric and Gas Co. Unique feature of this gas cleaning system is the elimination of manual control methods. Research-Cottrell, Inc has developed a system which will make Bergen the first station to use automation for the power inputs to electrostatic precipitators.

Electronic circuits will continuously monitor precipitator operation to maintain sparking rate, current, and voltage at the levels necessary to



obtain optimum fly ash collection efficiency.

The gas cleaning plant will consist of two combination mechanical-electrostatic precipitators which will clean 1,800,000 cfm of gas at 300 F with 98 per cent efficiency from two steam generators supplying about 4,000,000 lb per hr of steam.

Field tests show that with the automation system, power input to the precipitator averaged 65 per cent higher than with the level commonly employed with manual control (see graph).

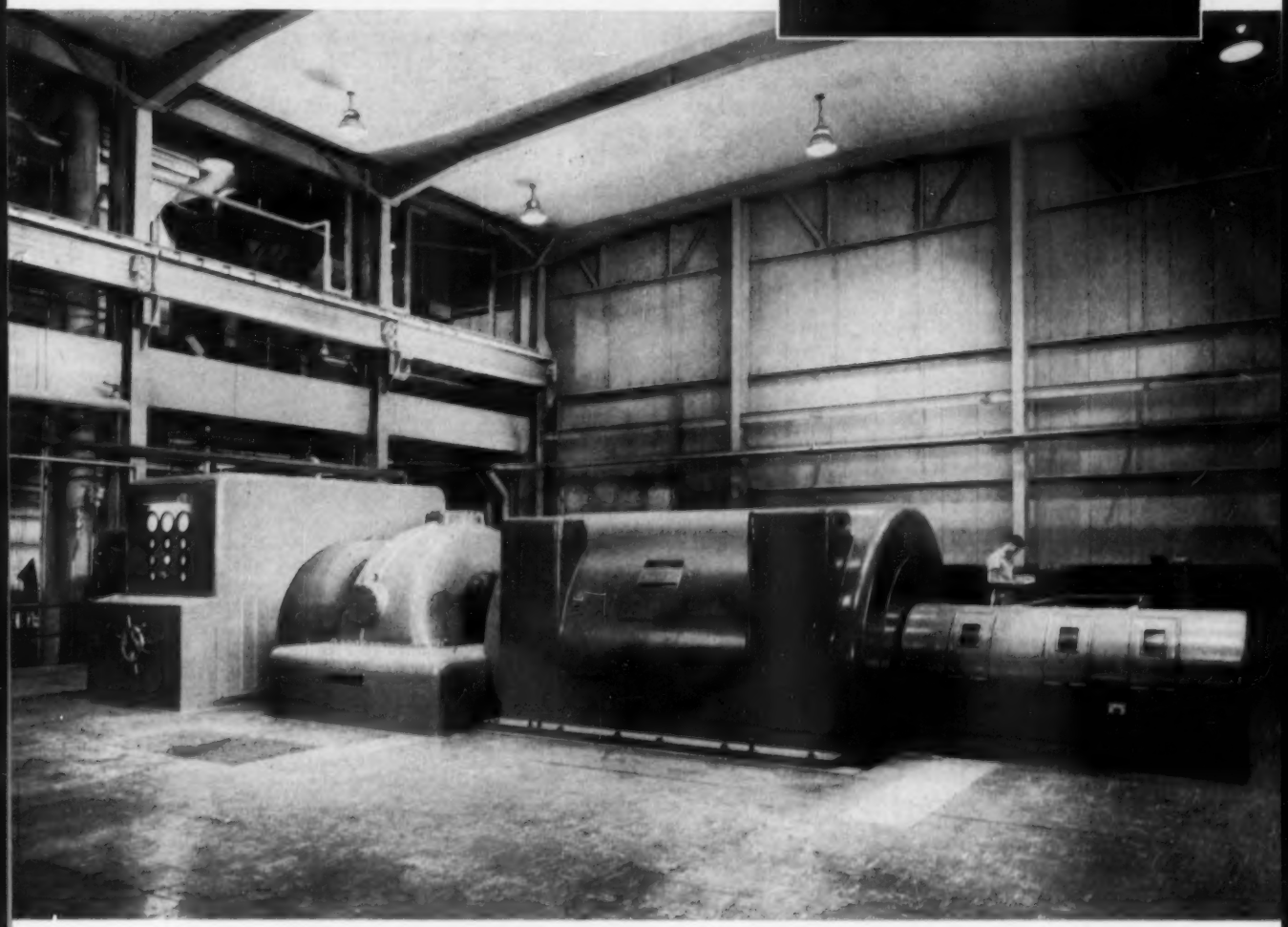
FIRE PREVENTION WEEK is October 6–12, and is a reminder that proper fire prevention practices are as important as ever. Last year, fires in all parts of the nation destroyed nearly a billion dollars worth of property and caused over 11,000 deaths. Electrical causes are rated as the principal reasons for industrial fires, and remember — the average life of portable fire equipment used in industrial buildings is 15 to 20 years. If yours is deteriorating much sooner than this, it's a sign there's something wrong with your preventive equipment maintenance program.

GIANTS IN THE FUTURE of ConEd of New York and Houston Lighting and Power of Texas will be new steam turbine generator units in the 2000-psig, 1050-F class. ConEd has ordered a 340-mw, 3600/1800 rpm, cross-compound turbine generator from Allis-Chalmers, for its Astoria Station. Houston Lighting and Power has turned to Westinghouse for what will reputedly be the South's largest turbine generator — a 275,000-kw, 3600-rpm tandem-compound, triple-flow unit, which will weigh more than 800 tons and measure 108 ft. Unit will be installed in a new power plant at Smithers Lake near Houston.

SHOULD YOUR CHILD be an engineer? T. Keith Glennan, president of Case Institute of Technology, writes on this theme in an impressive ad run this summer by the New York Life Insurance Co in *Life, Satevepost* and *Ladies Home Journal*. The ad is one of a series of public service ads being run by the company to present career opportunities for young men and women. Keith's answer to the question: he should be if he shows a natural aptitude for the sciences. "Frankly, I know of no profession that offers more today."

Henderson, Ky., selects a third

DE LAVAL
TURBINE
GENERATOR



In 1950,...
two De Laval 5,000 kw multi-stage turbine generators were installed in the central station of Henderson, Kentucky. These units operated so dependably that the City of Henderson ordered a new, larger De Laval turbine generator to meet their increased power requirements.

Put on the line in 1956,...
this 12,650 kw De Laval machine is an AIEE-ASME Preferred Standard Unit. It operates at 600 psig and 825F; the turbine speed is 3,600 rpm.

De Laval multi-stage turbines are rugged in construction, economical to run. Transmission of power may be either direct or through speed reducing gears. De Laval multi-stage steam turbines are available for all services, including operation at the high pressures, high temperatures employed in steam plants of the latest design. Units are built in sizes up to 25,000 hp.

DE LAVAL *Turbine Generators*

DE LAVAL STEAM TURBINE COMPANY
816 Nottingham Way, Trenton 2, New Jersey

WHAT THEY TELL US

▶ **CONTROL VALVE SIZING** problem for a heat exchanger is bothering Reader John I. Kolesnik of Philadelphia. He writes:

> I have the upstream pressure and the capacity required by the heat exchanger. Now, in order to determine the valve size required I need a pressure drop figure. Usually, or theoretically, the control valve should take 50 per cent of the pressure drop of the system, and yet I cannot get the pressure drop of the heat exchanger even from a leading manufacturer.

Designers have their own methods for figuring the heat transfer in a tube bundle in an exchanger, but these methods are not often given in the books. As we go to bat for Reader Kolesnik with some of the heat exchanger manufacturers, we would appreciate helpful comment and explanation from other readers.

▶ **HUNDREDS** of requests have come to us for the pump maintenance record card published in the Handbook section of the May, 1957 issue as part of the article, Pump Maintenance Records Pay Dividends, page 102. Reader E. H. Bradbury of Boston is among the latest to write for this:

> We saw your offer of maintenance record cards for pumps in the May issue of POWER ENGINEERING. Please send me 25 cards. We think this magazine has some wonderful information for everyone connected with power machinery. There is always something of value in it which we can use. Thank you very much.

▶ **PIPE SIZING** is an important engineering chore, and simple, accurate methods of dealing with it always seem important to us. That's why we published Paul R. Lutz's pipe sizing chart in the February, 1957 issue, pages 92–93. This chart is still drawing favorable comment. Now H. D. Fisher, of New Haven, Conn., writes:

> The Lutz pipe sizing diagram is the most practical I have seen. I was particularly interested in seeing whether Mr. Lutz had compensated for the variation in friction factor. This may be anything from 0.012 to 0.030, and as it appears in the formula could cause considerable error in the result unless the variation is provided for. Checks on a few scattered points seem to indicate that this variation has been taken into account, and I wish to compliment Mr. Lutz on the design of his diagram, which seems particularly adapted to doing this, and also provides a very wide range of pipe sizes and fluid flows. As Mr. Lutz implies, relating pressure drop to static pressure in this way makes the lines of the diagram correspond pretty well with usual practice, so that the diagram is pretty much direct reading.

▶ **PACKAGE POWER REACTOR** now operating at Fort Belvoir, Va., was described in detail in our June 1957 issue (pages 78–81). Now comes along a note from Col. J. B. Lampert of the Corps of Engineers and chief of the Army Reactors Branch, Division of Reactor Development:

> The APPR Begins Operation at Fort Belvoir was a very interesting and factual article. We who have been associated with the project enjoyed and appreciated this excellent coverage of the development and construction by the AEC of the Army's first nuclear power plant.

▶ **100 TONS OF FLY ASH** and furnace bottom ash a day is a problem in disposal for Charles Hiss, manager of Goodyear Tire & Rubber Co's Steam Engineering Division. Hiss asks:

> Can you refer me to any articles that describe a method for producing a product (such as sintered material) that would be equivalent to grate-produced cinders? Reference to any other process for producing a material of use or any outlet for our material would be appreciated.

Some experimental work has been done on producing a sintered material from fly ash, but nothing commercially feasible, to our knowledge. Detroit Edison Co has done a lot of work on fly ash disposal. Also, the Chicago Fly Ash Co was formed originally to handle disposition of, and to develop markets for, the fly ash from Commonwealth Edison Co, and has done authoritative work in this field.

In Wisconsin, there are two organizations which develop disposal methods and outlets for fly ash. One is Milwaukee Fly Ash Co; the other is the Wisconsin Fly Ash Co.

Finally, three articles on fly ash disposal published in POWER ENGINEERING give some idea of the possibilities: Fly Ash May Yield Commercial Germanium, January, 1954, page 65; Who'll Buy My Fly Ash?, April, 1954, page 70; Fly Ash Hits the Road, October, 1954, page 80.

▶ **AFTER** his four months trip to Europe last year, our peripatetic Editor, Andy Kramer, went off again this last summer, again to England and the Continent. This year he claims his trip was pure vacation; he insists that he indulged in no business entanglements. Yet he tells about visiting CERN, the big Central European Nuclear Research Establishment at Geneva, Switzerland; "Het Atoom" the International Atomic Exposition at Amsterdam; and of interviews with various officials of the Central Electricity Authority of Great Britain. So it appears to us that Andy just cannot let business alone even though he thinks he is doing just that.

At CERN, he saw the 197-in. 600-Mev synchrocyclotron in the process of undergoing its final testing. However, the thing that is really impressive at CERN is the foundation for the magnet ring of the huge 25,000,000,000 electron volt strong focusing proton synchrotron, which is undergoing construction. Only the foundation for this great machine is completed but some idea of its vast proportions can be had by standing on one side of the foundation structure and looking across its almost 1000-ft diameter. It is expected to be in operation sometime in 1961.

However, the thing that astonished Andy most at CERN was the complete absence of what we over here call *security*. As he relates it, "We merely drove out to the site from Geneva, making no appointments or requesting permission for the visit from anybody. Driving right smack into the middle of the site, we got out of the car, wandered into the synchrocyclotron building and stopped to look at anything that struck our fancy. We stopped to talk to some of the scientists, told them who we were, and they immediately stopped what they were doing and showed us around. There were no guards, nobody asked us any questions, nor was anybody concerned about our presence. I asked one of the scientists about security measures,

continued on page 118

One of a series.

Some Things to Think About Steam Traps

...in order to get high operating efficiency and a minimum of maintenance

The gentleman who invented the wheel had a basic idea and so far no one has come up with anything better for the purpose.

If you'll pardon us for a little overemphasis on the significance of steam traps, we'd like to liken one of them to the wheel.

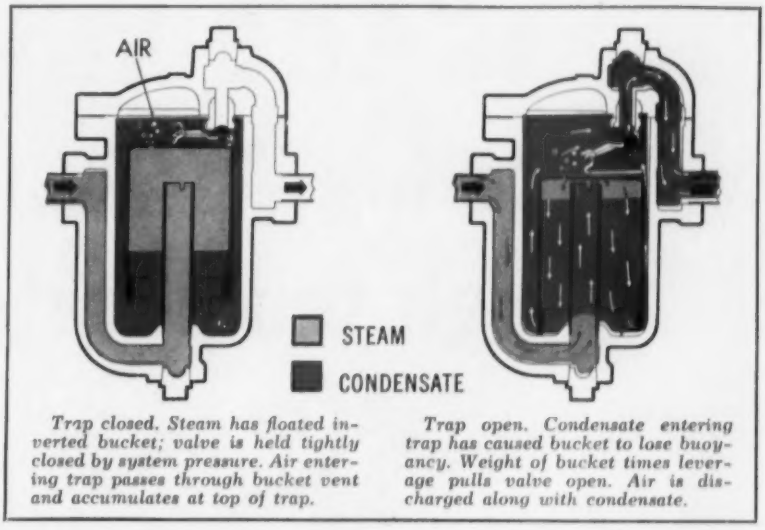
In 1911, when the first Armstrong inverted bucket steam trap model was announced to the world, or at least that part of the world that modest advertising and sales budgets would cover, it was not received with equal enthusiasm by all (especially old-style trap makers). But, like the wheel, it managed to find its way into general use. And, nothing better has ever turned up for the purpose of draining condensate. As a matter of fact, the Armstrong trap has been very widely copied. Today, there are more inverted bucket traps draining process equipment than any other kind. Of these, there are more Armstrongs.

If this sounds like the boasting of a proud parent, give consideration to some fundamental requirements not met by all traps:

1. ***A steam trap should not leak steam.*** Some traps do, you know, because of the nature of their operating principle. No steam ever gets to the Armstrong trap orifice. The valve is always water sealed.

2. ***A steam trap should vent "air" as fast as it accumulates***—otherwise temperatures are reduced and corrosion is a problem. The Armstrong trap handles air very nicely. The vent in the bucket permits air to accumulate in the top of the trap, from where it is discharged when the trap opens. For extreme conditions like draining paper machine dryers, some jacketed kettles and certain other units, the vent is sized larger for the job. And, for handling big volumes of air during warm-up, a bucket with an auxiliary thermic vent really speeds up heating.

3. ***A steam trap should discharge condensate at steam temperature*** if you want to get maximum efficiency from the unit drained. And most people certainly do. If you have to wait for the condensate to cool, it's almost impossible to maintain maximum temperatures and prevent air build-up. You guessed it—the Armstrong trap opens for water, without dependence on temperature.



Trap closed. Steam has floated inverted bucket; valve is held tightly closed by system pressure. Air entering trap passes through bucket vent and accumulates at top of trap.

Trap open. Condensate entering trap has caused bucket to lose buoyancy. Weight of bucket times leverage pulls valve open. Air is discharged along with condensate.

4. ***A steam trap should be suitable for any return system.*** The Armstrong trap works just the same whether discharging to atmosphere, back pressure or vacuum. It has been conclusively proved that flash steam resulting from use of a bucket trap does not cause a problem in vacuum return systems. The flash condenses rapidly. It's the leaky traps that cause the headaches.

5. ***A steam trap should not be a "prima donna".*** Some kinds of traps take an awful lot of care and coddling. The Armstrong trap is a rough and ready type with a hardened chrome steel constitution (valve and seat, to be exact). It cleans itself of ordinary dirt and scale without choking up. Its 18-8 stainless parts stave off rust and corrosion. It resists wire-drawing and wear remarkably well. In fact, it stays on the job longer with less attention than any trap ever produced. Unless you live in Siberia, you can probably find a user around the corner who will tell you so from experience.

6. ***A trap should not be an "orphan".*** With Armstrong traps you can *always* get prompt service and parts from nearby Factory Representatives and stocking distributors as well as from the factory.

7. ***A trap should have a guarantee.*** The Armstrong trap is unconditionally guaranteed to give you *complete satisfaction* (as to doing its job, that is). If it doesn't, you can get your money back.

If you'd like to buy some of these excellent steam traps, call your local Armstrong Representative or write **Armstrong Machine Works, 8101 Maple St., Three Rivers, Michigan.**

ASK FOR the 44-page Steam Trap Book, free on request without obligation.

ARMSTRONG STEAM TRAPS

For more data circle 505 on Post Card

WELBOND®

is the valve for high pressures, high temperatures

Yarway Welbond Valves are available in 9 sizes, ¼" to 2½", angle and straightway designs. Pressures to 2500 psi, temperatures to 1050° F.

Welbond is the valve designed by Yarway specifically to provide modern steam power plants with the ultimate in high pressure, high temperature valve service.

These special Welbond features insure improved valve performance:

- **Stem** of 321 stainless steel, used with special **packing** to prevent stem corrosion
- Easy and quick **accessibility.** All working parts removable through yoke.
- Non-distorting, thermally-compensated **seat**
- Ventilated, easy grip **handwheel**
- **Streamlined flow** through body

Welbond Valves are winning approval on superheater vents and drains, water wall drains, economizer drains, steam gage shut-off, strainer blow-off and many other steam plant services. Your Yarway man will be glad to discuss applications for your plant.

For full information, write for Yarway Bulletin B-452.

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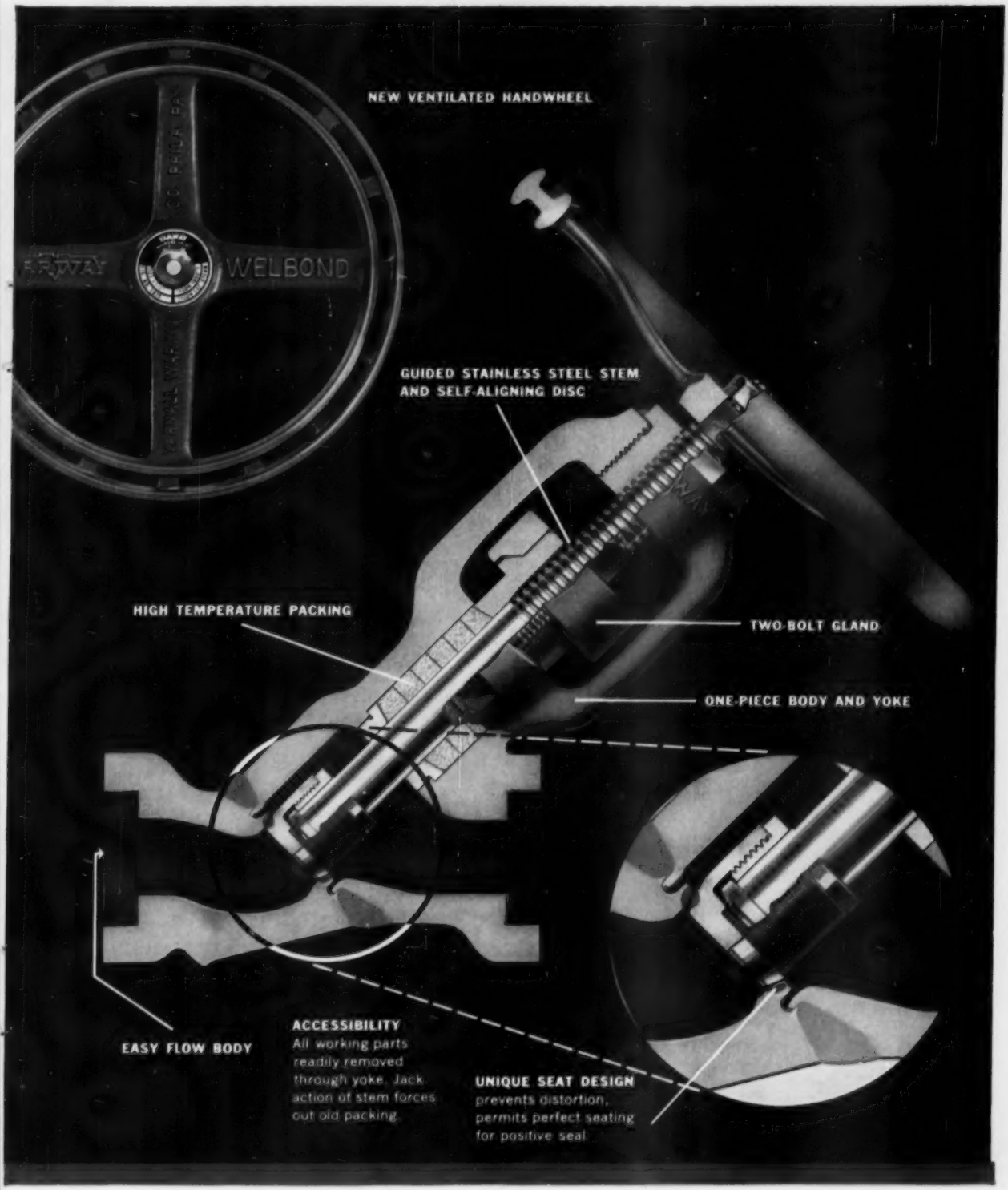
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY WELBOND · · a good


NEW VENTILATED HANDWHEEL
WELBOND
GUIDED STAINLESS STEEL STEM
AND SELF-ALIGNING DISC
HIGH TEMPERATURE PACKING
TWO-BOLT GLAND
ONE-PIECE BODY AND YOKE
EASY FLOW BODY
ACCESSIBILITY
All working parts readily removed through yoke. Jack action of stem forces out old packing.
UNIQUE SEAT DESIGN
prevents distortion, permits perfect seating for positive seal

way to specify high pressure/high temperature valves

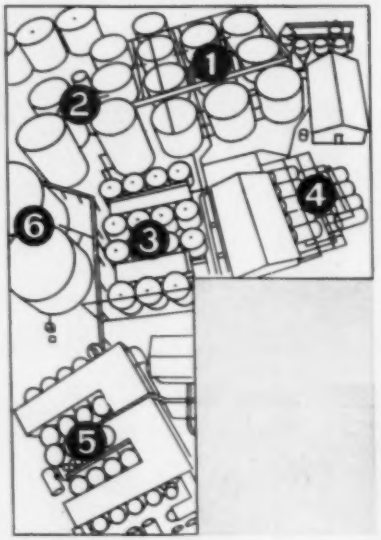
For more data circle 506 on Post Card

Water-tower view of PERMUTIT water-treatment equipment at Gulf States Utilities Company's Louisiana Power Station, North Baton Rouge, La. Engineered and constructed by Stone and Webster Engineering Corp.

12 million gallons of make-up per day

This station needs a *large volume* of water because it sells its steam to a refinery for process and requires 100% make-up. It needs *high-grade* water because it has adopted high-pressure boilers and turbines. It needs *efficient* treatment because it uses muddy Mississippi River water and well water with high solids and silica.

HERE'S HOW THIS 26-YEAR OLD PLANT HAS KEPT UP TO DATE *(see diagram):*



1. Original *batch coagulation and settling tanks.* Some are still used for secondary treatment of river water to reduce silica.

2. The 1931 roughing sedimentation tanks were converted to modern up-flow *Precipitators* in 1938 . . . cutting hardness 20%, turbidity 40%—and tripling capacity.

3. *Gravity filters* polish the clarified river water prior to softening.

4. Old Zeo-Dur® *zeolite softeners* were converted to new Zeo-Karb® exchanger in 1937 . . . boosting each unit's capacity 55%.

5. *Demineralizers* for new high-pressure boilers were added in 1955. They treat 3500 gpm, reduce dissolved solids of well water from 271 to under 2.0 ppm and silica from 25 to less than 0.1 ppm. Completely automatic PERMUTIT controls determine end-points, rinse, backwash and regenerate units and return them to service . . . even prepare regenerating solution.

6. *Tanks* store the high-quality, low-cost demineralized feedwater.

Whether you need one piece of water-treatment equipment . . . or acres of it, PERMUTIT has the know-how . . . earned by experience. This knowledge is at your service. Write The Permutit Company, Dept. PE-10, 330 West 42nd Street, New York 36, N. Y. or Permutit Company of Canada, Ltd., Toronto 1, Ont.

PERMUTIT®
WATER CONDITIONING
Equipment • Resins • Experience

Demineralizers • Zeolite and Hot-Process Softeners • Dealkalizers • Deaerating Heaters • Pressure and Gravity Filters • Chemical Feeders • Aerators • Blow-off equipment • CO_2 Indicating Recorders • Zeolites and Resins • Instrument Panels • Control Cubicles.

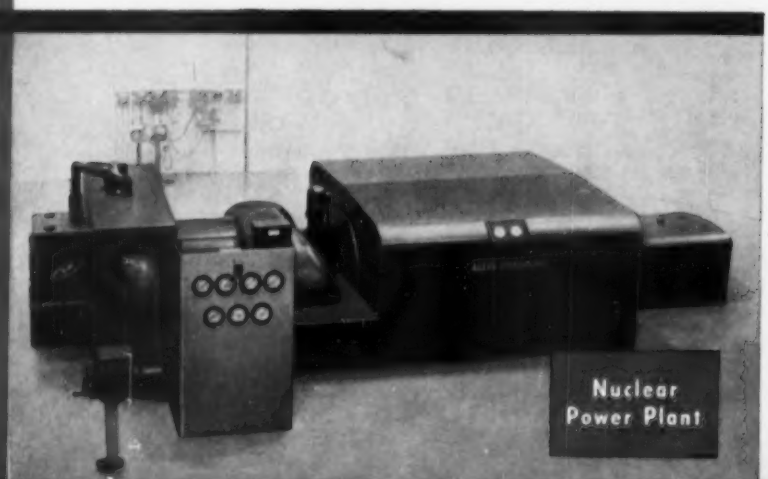
ONE OF THREE Allis-Chalmers steam turbine generator units in a large brewery. This 5000-kw condensing, automatic extraction, impulse unit generates electricity as a by-product of process steam.

ALLIS-CHALMERS STEAM

The Choice of

LARGE QUANTITIES of steam are required for heating, laundry, and other services. These 3000-kw Allis-Chalmers non-condensing, automatic extraction turbine-generator units supply steam at two pressures as well as electric power.

A MINNESOTA CITY supplies business district and residential heating steam, and electric power with this recently installed 7500-kw condensing, automatic extraction steam turbine generator unit.



THIS 5000-kw condensing steam turbine generator unit was designed to meet the special requirements of a nuclear power plant. In addition, Allis-Chalmers supplied the switchgear, condenser, pumps, motors and other auxiliaries.

TURBINE GENERATOR UNITS

Modern Power Plants

Condensing . . . non-condensing and automatic extraction units are available for wide range of services

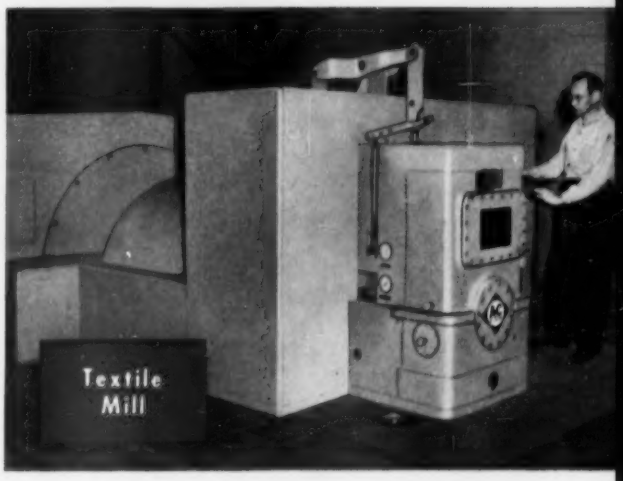
UTILITIES, breweries, textile mills, medical institutions, and a nuclear power plant enjoy the low installation and operating costs of Allis-Chalmers WA-Series steam turbine generator units.

These modern, compact units complement the most modern plant design. They are built in NEMA ratings through 10,000 kw . . . AIEE-ASME preferred ratings to and including 16,500 kw.

Users of these Allis-Chalmers turbines enjoy an important advantage. "Big turbine" features are incorporated in their design.

For example, the centrifugal-type speed governor is the same type used in large Allis-Chalmers steam turbines. Steam seals are the same labyrinth type used in turbines up to 300,000 kw. Removable external glands, high chrome alloy steel buckets and nozzles are other features. The 16,500-kw units with hydrogen-cooled generators have the same type of hydrogen seals as used on the large sizes.

Unit shipment with rotors individually locked in place cuts installation time and cost. Foundation cost is reduced because oil piping and generator air coolers are above the floor line.



PROCESS STEAM in a synthetic yarn plant produces electric power as a by-product with this 5000-kw non-condensing steam turbine generator unit.

GET MORE FACTS on these economical units. Call your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

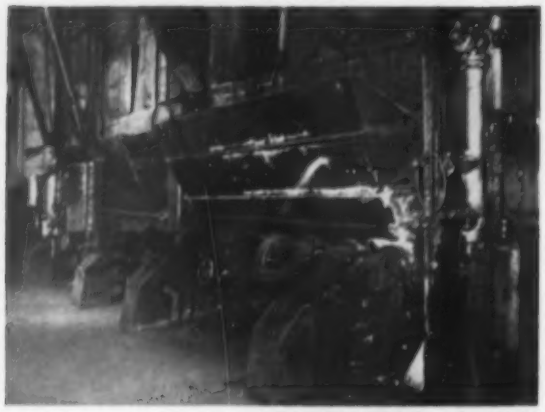
A-C ALLIS-CHALMERS

A-5437

ALLIS-CHALMERS

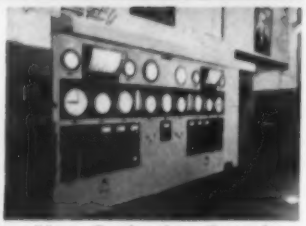
For more data circle 508 on Post Card

Power Plant Modernization at

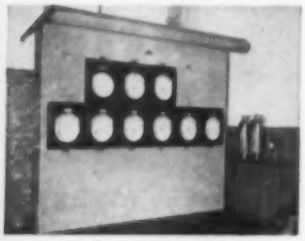


Two 30 year old stoker fired boilers that were replaced.

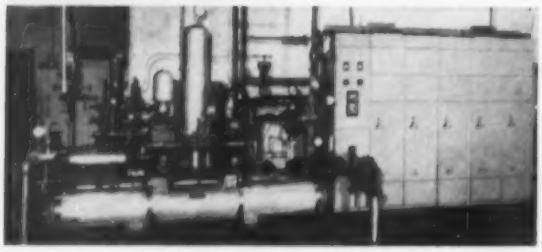
New Ash Storage Silo.



New Combustion Control Panel Board.



New Steam Flow Meter Panel Board.



Oil Heater and Load Center.

A survey of your plant by a consulting engineer could show ways of making surprising savings in your power costs.

Power MODERNIZATION PROGRAM

A 1956 POWER CITATION WINNER

Replacing two of six 6000 sq. ft. horizontal water tube boilers with

TWO 60,000 LBS/HR RILEY BOILERS Complete with Riley Coal/Oil Burners, Riley Pulverizers, Automatic Controls *give Thomas A. Edison, West Orange, N. J.*

- **Doubled steam capacity per sq. ft.**
- **16% increase in boiler efficiency**
- **More flexible fuel selection**
- **A 20% annual return on net investment of 2.75 mills per Btu.**
- **A reduction in coal and stoker parts inventories**

Here again is a modernization program that proves conclusively that it pays to modernize . . . and with Riley boilers and fuel burning equipment. Because Thomas A. Edison Industries selected Riley equipment it was able to integrate both boiler and fuel burning equipment into a system that has produced outstanding savings, higher boiler efficiencies, higher fuel economies, lower maintenance and reduced operating expense.

The Riley RX Boiler is compact; with the exclusive single header hopper as an integral part of the furnace it provides ideal conditions for firing high ash coals and multiple fuels. The RX Boiler with single header hopper bottom is particularly recommended for installation in plants that will be firing coal at some future date.

RILEY

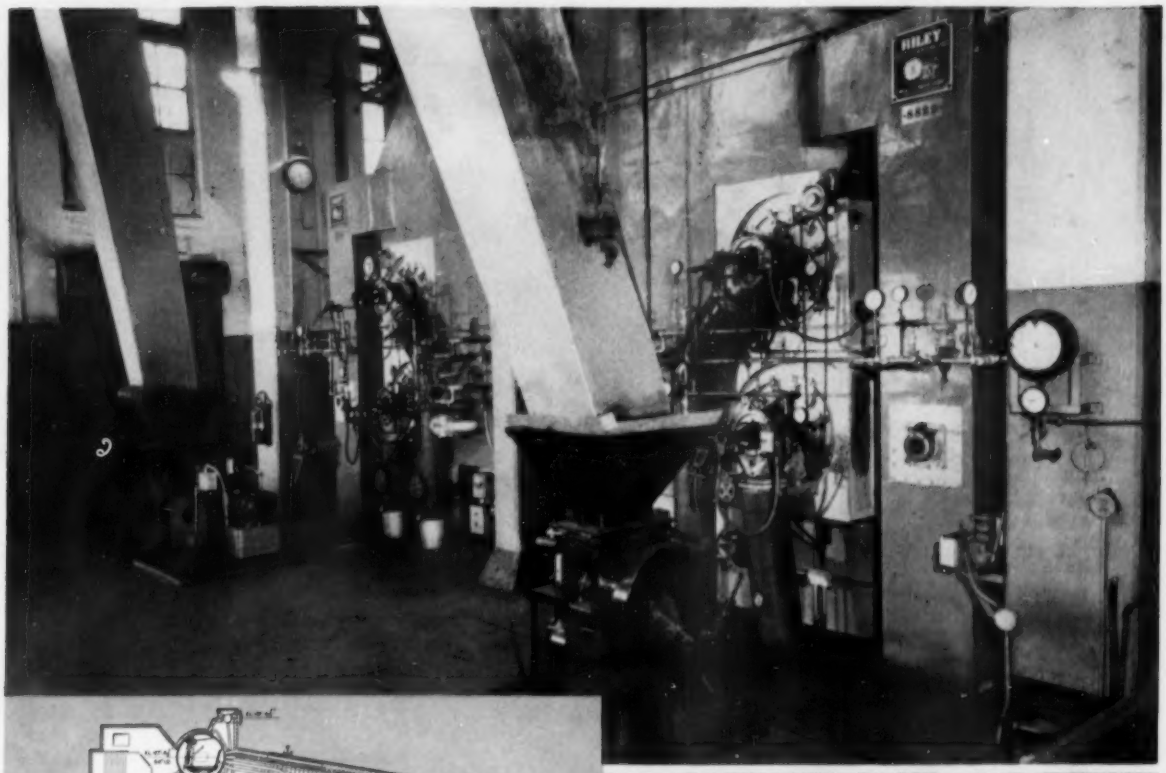
Stoker Corporation

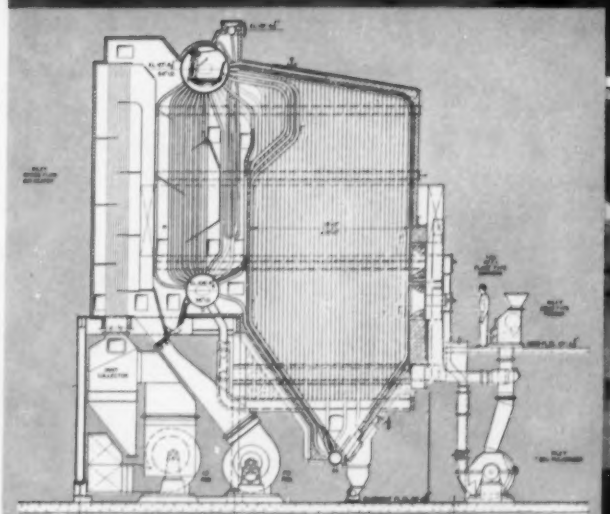
WORCESTER, MASSACHUSETTS

Sales Offices: Worcester, New York, Philadelphia, Buffalo, Pittsburgh, Cleveland, Detroit, Chicago, Cincinnati, Charlotte, New Orleans, Atlanta, St. Louis, Kansas City, St. Paul, Houston, Denver (Englewood), Salt Lake City, Los Angeles, San Francisco, Portland, Seattle.

Thomas A. Edison Industries

DIVISION OF McGRAW-EDISON COMPANY — WEST ORANGE, NEW JERSEY





Boiler Capacity 60,000 lbs/hr. 515 F, 450 design psig.

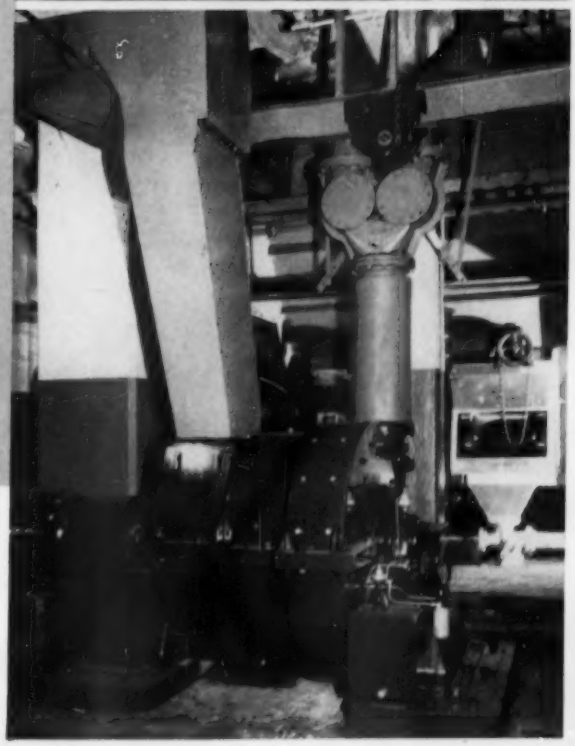


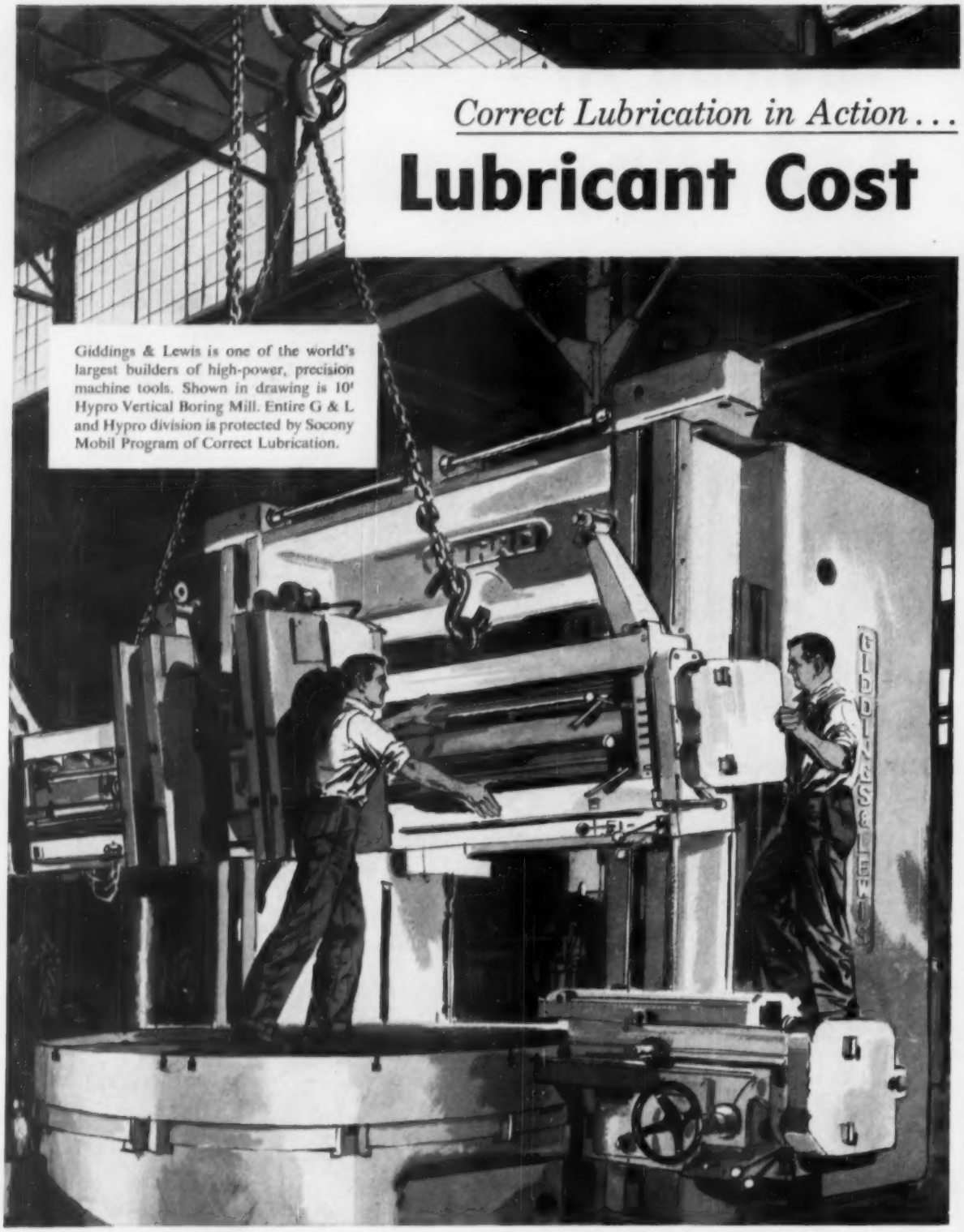
Photo above shows arrangement of Riley Coal/Oil Flare Type Burners in common secondary air duct. Two Riley Coal Feeders are in foreground.

At right is one of the two #350 Riley Pulverizers. This is the smaller size pulverizer particularly adapted for use in industrial installations. Its quietness and its vibrationless operation are two of its most unique and most desirable features. Tungsten carbide facing on pulverizing elements resists erosive effects of abrasives in high ash coals, reduces maintenance outages. Riley Pulverizers operate efficiently with the wettest coals.

For more data circle 509 on Post Card

Correct Lubrication in Action . . .

Lubricant Cost



Giddings & Lewis is one of the world's largest builders of high-power, precision machine tools. Shown in drawing is 10' Hypro Vertical Boring Mill. Entire G & L and Hypro division is protected by Socony Mobil Program of Correct Lubrication.

Mobil **SOCONY MOBIL**

Leader in Lubrication for over 91 years

in the **Machine Tool Industry**

Per Machine Cut 18%

One of many ways Giddings & Lewis Machine Tool Company has increased profits with the help of Socony Mobil

To Giddings & Lewis, one of the most direct ways to increase net profits is to reduce maintenance costs. That's why this company, a leading builder of quality, high-precision machine tools, relies on a Mobil Program of Correct Lubrication.

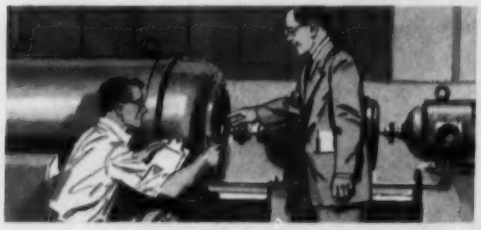
In just three years a Mobil "team" of lubrication specialists, working closely with plant personnel, cut lubricant costs per machine 17.9% . . . reduced lubricant application cost 7.6%.

These savings were but a few of the many and varied cost-cuts achieved through Mobil products and Mobil service. They reflect the many hours spent by Socony Mobil field and laboratory personnel in studying machine operations, preparing technical reports, making analyses of products in use.

Why not rely on a Mobil *Program of Correct Lubrication* to help *you* improve production and reduce maintenance costs?

Can you afford to accept <u>less</u> than a cost-cutting service like this?

After a Mobil representative makes a lubrication analysis of your plant, a program of Correct Lubrication is put into action. Described below are some of the features of this program and how they benefited Giddings & Lewis.



Lubrication specialists, the most experienced in the petroleum industry, are ready to help you solve the knottiest lubrication problem. **For example, a Mobil engineer helped G & L solve a problem of repeated bearing failures on shop planers. His lubricant recommendation eliminated the trouble . . . saved $244 a year on each planer.**

Constant Quality Checks are kept on Mobil lubricants in use. Socony Mobil offers more analytical service than any other oil company. As a result, you can *safely* get maximum life from every Mobil product. **At the G & L and Hypro division Mobil quality oils are repeatedly filtered and put back to work. Periodic checks by Mobil laboratory analyses show oils to be in "like new" condition even after years of service.**

Thorough knowledge of machine design—Mobil engineers work closely with designers and builders . . . advise on hydraulic and lubrication system design . . . suggest the correct products for each machine. **G & L affixes a lubrication plate to every machine they produce. It specifies the use of the right Mobil product (or equivalent quality) to assure satisfactory operation wherever these machines are used.**

In-plant training clinics are conducted by Mobil engineers. Maintenance personnel are instructed in proper application procedures . . . taught to recognize trouble before it occurs. **At G & L, frequent electric motor failures were found to be caused by over-application of grease. Instruction corrected this trouble . . . reduced application time by 66% . . . cut grease consumption, too.**

Correct Lubrication

A <u>proved</u> program to reduce maintenance costs

SOCONY MOBIL OIL COMPANY, INC., and Affiliates: MAGNOLIA PETROLEUM CO., GENERAL PETROLEUM CORP., MOBIL OVERSEAS OIL CO., INC.

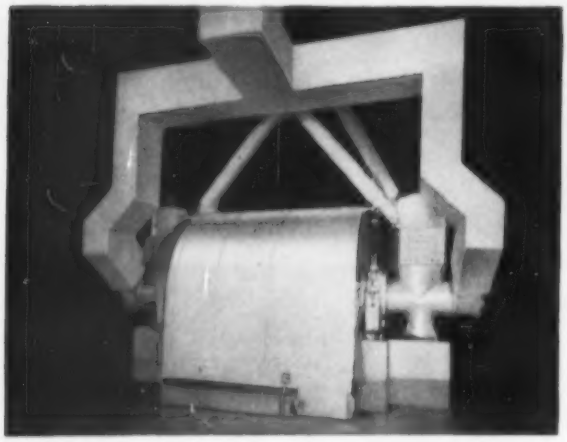
For more data circle 510 on Post Card

HEAT ENGINEERING by FW

for MAJOR STEAM GENERATING and

STEAM generator design and heat engineering are virtually synonymous. The problem is basically one of generating heat and transferring it to water and water vapor to produce a dependable and abundant source of steam at the desired temperature and pressure. To do this most efficiently and economically calls for heat engineering of the highest order.

With over 50 years of world-wide experience in this specialized field, Foster Wheeler is exceptionally well equipped to meet the most exacting requirements of the modern, high pressure steam generating plant. Starting with the commercial introduction of superheated steam in the United States in 1902, Foster Wheeler has pioneered and developed many major advances in steam generator design, including convection and radiant superheaters, air preheaters, high-pressure economizers, twin furnace construction, dual circulation and improved drum internals for high steam purity. And heat engineering by Foster Wheeler is continually researching and exploring new concepts of design to anticipate the needs and solve the problems of steam generating plants of the future. For information on equipment to meet your specific requirements, write to *Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.*

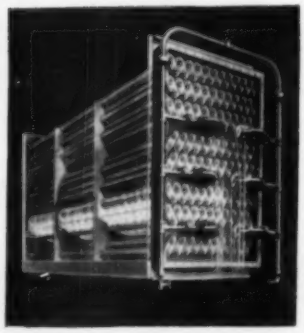


PULVERIZED FUEL was first developed on a commercially successful scale by Foster Wheeler in 1898. Today, FW ball mill pulverized fuel systems have a total installed capacity of more than 12 million pounds of coal per hour. The FW ball mill offers the proved advantages of constant fineness, high availability, large reserve capacity and ability to handle hard and abrasive fuels.

The new planetary roll and table pulverizer, introduced in 1956, supplements the FW line with a compact and highly efficient unit that is very economical and easy to maintain.

SUPERHEATERS of the convection and radiant type, used singly or in combination, provide constant superheat and accurate control of final temperature over a wide load range. The first radiant superheater was installed by FW in 1917 and since that time, approximately one thousand units have been put in service.

ECONOMIZERS. The extended surface, cast-iron-covered economizer, developed by Foster Wheeler, assures maximum heat transfer from boiler exit gases to boiler feedwater. The FW design has proved to be highly corrosion resistant, impervious to soot fires and easily cleaned.

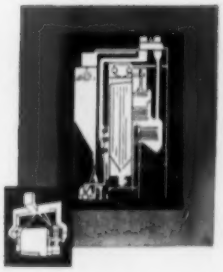


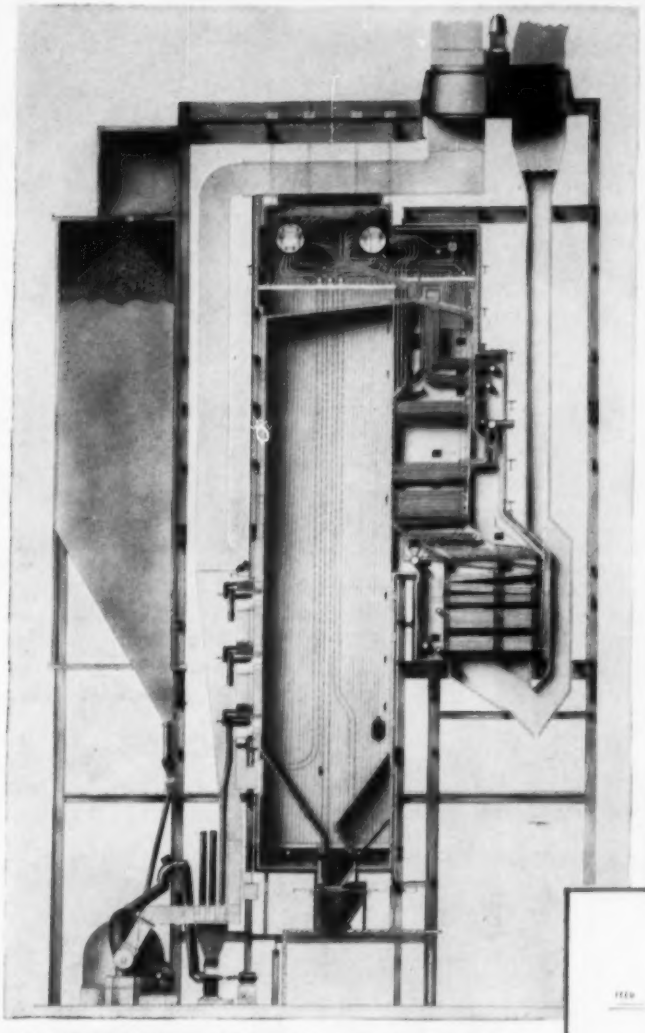
FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

sets the highest standards

PULVERIZING EQUIPMENT



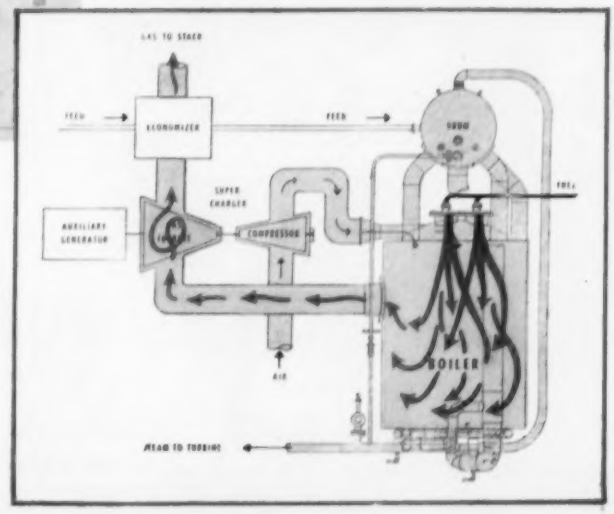


DUAL CIRCULATION was introduced by Foster Wheeler in 1946, providing the first practical solution to the problem of providing high purity steam at pressures above 600 psi from feedwater containing relatively high silica. This is achieved by dividing the steam generator into two separate sections – a high heat absorption primary and a low heat absorption secondary section. Blowdown from the primary is fed into the secondary section, from which steam is delivered to the separating equipment and condensed by incoming feedwater. Hence the primary section, where virtually all of the output steam is generated, is maintained at a very low concentration of impurities. This sharply reduces silica carryover and total dissolved solids in the steam.

REHEAT. The reheat cycle, also pioneered by Foster Wheeler, has resulted in important fuel savings and increased operating efficiency for large central station and industrial steam generators. The list of major FW reheat projects includes a unit capable of producing 2,000,000 lb/hr to serve a 300,000 kw turbine generator.

This Foster Wheeler unit, placed in operation in 1955, is the first **dual circulation, reheat** steam generator ever built with a capacity of more than 1,000,000 lb/hr

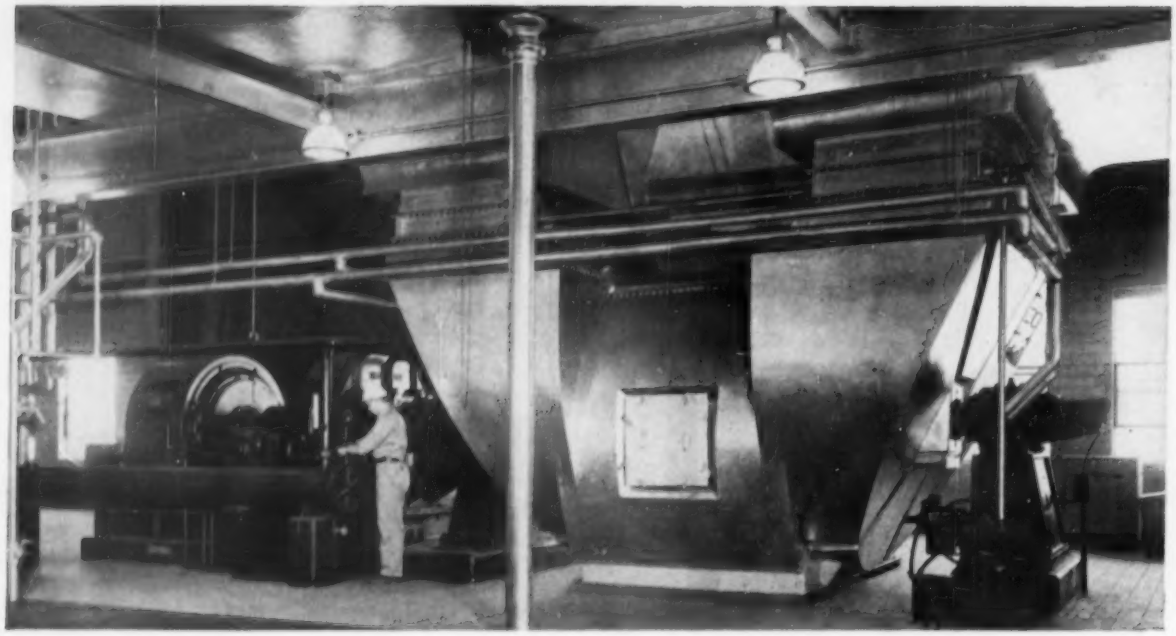
THE SUPERCHARGED BOILER is a revolutionary new development, announced by Foster Wheeler in 1956 and still under investigation and test. It offers the advantages of high overall economy, drastic reduction in size and weight, short startup time, quick load response and shop-assembled construction. High pressure discharge gases from the furnace are used to drive the combustion air compressor and an auxiliary generator which can supply up to 15% of total plant output. Further details are available on request.



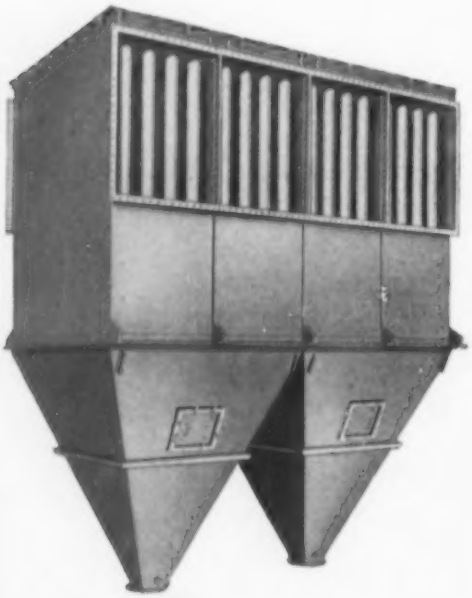
For more data circle 511 on Post Card

American Blower Air-Handling Equipment

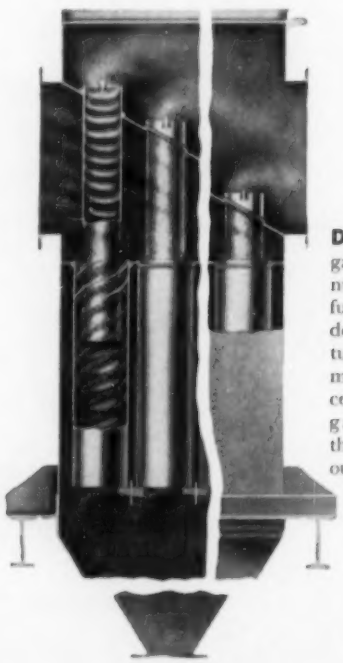
Proved efficiency



American Blower Induced-Draft Fans offer high static efficiency at low rpm. Like all American Blower mechanical-draft equipment, they are accurately formed and welded; fan rotors carefully balanced; all parts are minutely inspected for dimensional accuracy. They require a minimum space and minimum maintenance.



Series 342 Precipitator is easy to install and very effective in controlling fly ash. The over-all performance of each tube is comparable to the high efficiency of a small-diameter cyclone.



Dust-laden air or gas enters inlet plenum; gravity and centrifugal action force dust downward, adjacent to tube wall; dust is skimmed into gas-tight receptacle; cleaned air or gas moves upward through outlet tubes to outlet plenum.

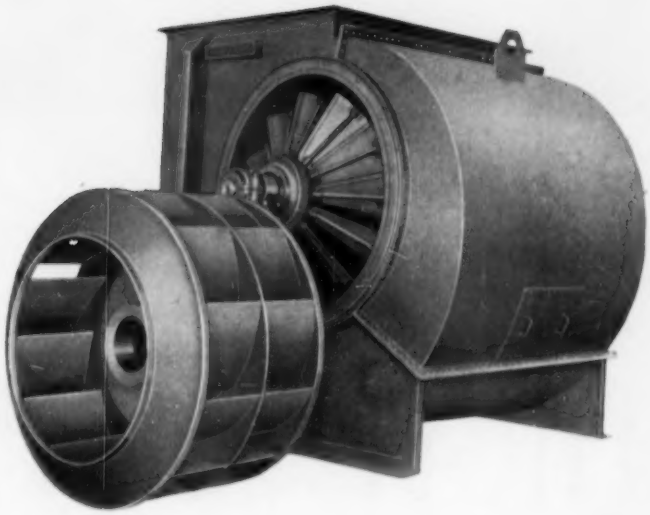
. . . maximum performance!

American Blower Mechanical Draft Fans

To meet the peak efficiency demanded of mechanical-draft equipment today, you'll be better off if you select spacesaving and efficient American Blower Mechanical Draft Fans.

Combining modern manufacturing methods with perpetual research and development, American Blower produces complete fan equipment for all types of mechanical draft. These induced-draft or forced-draft fans will fit your exact specifications with minimum maintenance and minimum boiler "outage."

If you are investigating mechanical-draft equipment—for new or existing installations—you'll do well to check on American Blower's line of Mechanical Draft Fans with guaranteed performance ratings. We welcome the opportunity of quoting on your requirements.



Forced Draft Fans for quiet indoor or outdoor installations. Heavy, reinforced housings and wheel-shaft assembly mean longer life, while special streamline inlets give utmost efficiency.

American Blower Precipitators

For maximum collection efficiency, choose the *best*—a dependable American Blower Precipitator!

Your fly ash problems can be met by installing a Series 342 Fly Ash Precipitator which offers good efficiency over the normal operating range, while it gives reliable, trouble-free performance.

American Blower's line of Fly Ash Precipitators and Dust Collectors has gained wide acceptance in leading public utilities and industrial plants.

For complete information on American Blower Dust Collectors and Precipitators as well as other air handling products, call our nearest branch, or write direct. American Blower Division of American-Standard, Detroit 32, Michigan. In Canada: Canadian Sirocco products, Windsor, Ont.

AMERICAN BLOWER

Division of American-Standard

QUALITY PROTECTS YOUR INVESTMENT... American-Standard QUALITY IS AVAILABLE AT NO EXTRA COST

For more data circle 512 on Post Card

THE CROSS COMPANY—Fraser, Michigan
Consulting Engineers, Giffels & Vallet, Detroit, Michigan

Installed at this new ultra-modern plant are two 12-million BTU capacity C-E Hot Water Boilers. When this pioneer producer of automation equipment studied their heating requirements, they calculated that this system would provide the lowest fuel and maintenance costs. Their actual winter operating experience proved the soundness of this decision.

CONVAIR-ASTRONAUTICS—San Diego, California
Consulting Engineers, Pereira & Luckman

When this division of the General Dynamics Corporation determined that more space was needed for their Atlas Intercontinental Ballistic Missile project, this new center for research, development, manufacturing, and primary testing of the Atlas was decided upon. Installed in this center of space flight research will be two 30-million BTU C-E Hot Water Boilers.

HIGH TEMPERATURE

ADVANTAGES

—of high temperature water:

1. Higher available heat—many times that of steam at the same pressure.
2. Closer control of temperature.
3. Lower heat loss . . . unused heat returns to the boiler . . . no condensate return lines.
4. No elaborate feedwater treatment . . . make-up requirements are exceptionally low.
5. Steam traps not required . . . trap problems and expense are eliminated.
6. No blowdown losses . . . no safety valve vent losses . . . no condensate losses.

—of the C-E Hot Water Boiler:

1. Complete control of circulation in system and boiler.
2. No separate boiler pump needed . . . pressure loss is low.
3. Pressurized operation with oil or gas means no induced draft fan.
4. Single-pass design—no baffles—means cleaner boiler and lower draft loss.
5. Controlled, positive circulation permits more efficient arrangement of heating surfaces.
6. Any fuel—oil, gas, coal, or any combination of fuels.
7. Gas-tight, welded steel casing.
8. Fewer headers, all of which are easily accessible.

COMBUSTION

Combustion Engineering Building

CANADA: COMBUSTION ENGINEERING-

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS;

RIVERVIEW COMMUNITY HIGH SCHOOL—Riverview, Michigan
Consulting Engineers, Bennett & Straight, Detroit, Michigan

To keep pace with the expanding need for more educational facilities, Riverview, Michigan has recently finished this fine, modern high school. Its heating requirements are met by two 10-million BTU C-E La Mont Controlled Circulation Hot Water Boilers.

U.S. AIR FORCE ACADEMY—Colorado Springs, Colorado
Consulting Engineers, Skidmore, Owing & Merrill

Typical of our Air Force's widespread acceptance of high temperature water for various of their installations is the selection of five C-E Hot Water Boilers for their new academy. These units will furnish heat for living, academic, and service areas here.

WATER today's new idea in large-space heating

In such diverse applications as industrials, large educational institutions, and military bases, high temperature water is finding rapidly increasing acceptance as an ideal means of heating large areas.

A big factor in bringing this trend about is The C-E La Mont Controlled Circulation Hot Water Boiler. Using the same principle as that applied by C-E in many of the country's largest utility boilers, this new boiler provides a degree of temperature control that makes it the most attractive method of heating in many cases. With a wide range of capacities – from 10 to 300 million Btu's – these boilers operate at water pressures up to 500 psi and temperatures to 470F, or higher. Depending upon local conditions, a C-E Hot Water Boiler can save from 10 to 20 per cent in maintenance and operating costs.

The smaller capacity Hot Water Boilers are completely shop assembled, while the intermediate and large units are shipped in varying stages of assembly. This C-E practice greatly reduces erection costs.

So, if you are in the market for boilers, either for space heating or process requirements, it may prove greatly to your advantage to investigate the use of high temperature water as your heat source. Because individual needs vary, both steam and hot water have their place. Our engineers will be pleased to discuss either method with you or your consultants —impartially and with no obligation.

For further details on high temperature water boilers by C-E write for our catalog HCC-2.

ENGINEERING

C-120

200 Madison Avenue, New York 16, N. Y.

SUPERHEATER LTD.

PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

For more data circle 513 on Post Card

Water goes to pieces in Atomic Power Plant!

$$2H_2O \xleftrightarrow{\text{radiation}} 2H_2\uparrow + O_2\uparrow$$

Water breaks up into hydrogen and oxygen! This is only one of the problems Nalco scientists have faced in planning water treatment with designers and builders of pressurized water nuclear power plants. There are several others which show, dramatically, that steam generation with nuclear fuel creates water treatment problems that are radically different from conventional steam generation . . . *And they also point up Nalco's program of keeping ahead in research and practical applied science.*

NATIONAL ALUMINATE CORPORATION

6224 West 66th Place • Chicago 38, Illinois

CANADA: Alchem Limited, Burlington, Ontario
NORTHWESTERN UNITED STATES, HAWAII and ALASKA:
The Flox Company, Inc., Minneapolis 3, Minnesota
ITALY: Nalco Italiana, S.p.A.
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Water goes to pieces — Excess hydrogen in water helps stabilize shaky water molecules.

Ammonia and nitric acid form in boiler water — Control dissolved gas concentrations in water.

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HELPFUL BULLETINS

METERS AND CONTROLS

101 Meters, Controls — Instruments introduced within the last year are included in the 8-pp 1957 edition of this company's Bulletin G15–1. Applications, ranges and detailed literature references are given for transmitting, recording, indicating and controlling instruments. Bailey Meter Co.

102 Pressure Regulators — Six-pp Folder AD-2268 describes company's bronze regulators for pressure control of air or steam at up to 250 lb and 450 F. Includes tables for selecting proper size regulator, plus diagrams and tips for making better installations, and a table of dimensions. Crane Co.

103 For Process Control — Bulletin MSP-141 describes company's Ring Balance recorders, indicators and controllers. Arrow and caption treatment explain proprietary features incorporated in these instruments designed for precise measurement and control of process variables. Hagan Chemicals & Controls, Inc.

104 Mechanical Btu Meter — Bulletin 1000 describes a completely mechanical instrument that measures heat in thermal units and liquid-flow in gallons with high precision. Construction and operation are described, selection data is included. Air Conditioning Equipment Corp.

105 The Systems Concept — The first of a series of ten contemplated educational booklets on "Systems Engineering Applied to Combustion Control," this 16-pp booklet introduces the systems concept which produces automation-in-combustion. Need for specific instruments for efficiency and safety, and their correct integration into the system is discussed. Reasons for and fundamentals of draft control, requirements and mechanics of draft control are treated, and interlocked controls and safety devices are explained. Diagrams and photos illustrate text. Cleveland Fuel Equipment Co.

106 On Hot Water Controls — Bulletin P-31 is offered as an aid in selection and application of controls for high temperature hot water installations. Diagrams show company's pump controls, water feeders and relief valves are used in high temperature systems. Selection tables are included. McDonnell & Miller, Inc.

107 Pneumatic Drive Units — Bulletin 1033 describes pneumatic power drive units for remote operation and positioning of valves, dampers, louvers, rheostats, vanes and variable-speed drives. Explains principle of operation, and gives mechanical specifications, table of sizes, torque ratings and weights, torque output curves and dimensional drawings. Copes-Vulcan Div., Blaw-Knox Co.

ELECTRICAL

108 Manual Motor Starters — Bulletin GEA-6358A, 8 pp, covers company's new small-size manual starters for fractional- and integral-horsepower motors up to 7½ hp. Includes new features, application and installation data, and a rating table for the new plug-in heaters. Illustrates open and closed forms with dimensions for each. General Electric Co.

109 Distribution Panelboards — Bulletin GEC-1253A describes construction features of Converti-Fuse panelboards, designed to distribute power from main feeders to power loads, to other distribution panelboards and lighting panelboards. Selection information and dimensions included. General Electric Co.

110 Electrical Connectors — Twelve-pp Bulletin S7 presents Sta-Kon pressure wire joints, terminals and connectors for wire sizes from No. 22 to 250 mcm. A chart for each type of connector lists wire range, stud size, dimensions and quantity per "pocket-size package." A section also covers installation tools — from hand plier types to high speed air-operated ones. The Thomas & Betts Co.

111 Conductor Code Chart — Past and present code name designations for aluminum electrical conductor are brought together in this reference wall chart. Lists alphabetically 600 code names and specifies type and size of products. Adjacent tables provide more detailed information, including data on coverings, messengers, sizes and strandings. British and U. S. standard tables are included on chart. Kaiser Aluminum & Chemical Sales, Inc.

LIGHTING

113 Selecting Floodlights — Bulletin GEA 6175A, 16 pp, discusses essential features of floodlighting installations, and provides glossary of terms and classification and application guide. Discusses general principles of floodlighting, explains floodlighting calculations, and provides tables of recommended footcandle levels for various types of installations, lists photometric data. General Electric Co.

114 Fluorescent Ballasts — Publication GEC-983K is a 16-pp selection guide covering company's line of fluorescent lamp ballasts. Contains a list of obsolete ballasts and suggested replacements for them. Also gives prices, data on ballast lead lengths, cross section dimensions, table on lead stripping and tinning, wiring diagrams, and electrical specifications. General Electric Co.

PUMPS, COMPRESSORS

115 Refinery Pumps — Component interchangeability is stressed in 12-pp Bulletin B-1605, illustrated in color. These pumps handle most refining process liquids, including petroleum hydrocarbons, chemical solutions and water. They are described and illustrated and performance curves are included. Peerless Pump Div., Food Machinery and Chemical Corp.

116 Blowers and Pumps — Blowers, gas pumps and vacuum pumps are described and illustrated in 8-pp Bulletin S-59F. Text covers characteristics of operation, construction and types of drive. Also provided are details on relief valves, timing gears and thrust bearing assembly. Standard blower dimensions are charted as are performance examples for low, medium and high pressure blowers in terms of horsepower, rpm and cfm capacity. Sutorbilt Corp.

117 Cooling Tower Preservation — Application Engineering Data Sheet D-57-1 discusses methods of combatting corrosion and delignification in cooling towers, using controlled volume pumps to meter precise quantities of chemicals to cooling water. Details and drawings explain continuous pH control using Mersemetric pumps, acid metered in proportion to flow rate, chemical feed with automatic level control. Milton Roy Co.

118 Exhausters, Compressors — Eight-pp Bulletin 4E describes company's exhausters — air and gas pumps which operate on the jet principle, at moderately high vacuum, using live steam or air as the motive force. Includes application, construction, and operation information on the various types and sizes for use in chemical service. Capacity curves, capacity ratios, and steam and air consumption tables, photos and sectional drawings amplify text. Schutte and Koerting Co.

119 Water Jet Exhausters — Sixteen-pp Bulletin 4P describes single- and multi-nozzle water jet exhausters, water jet laboratory vacuum pumps, and barometric hydro-vac exhausters. Provides application, construction and operation information on each type and gives sizes and dimensions. Capacity curves and ratios, and water consumption tables are included, also tables showing pump priming capacities. Bulletin also shows a line of exhausters for corrosive vapor service. Schutte and Koerting Co.

FANS

120 Air Engineering — Bulletin E-57 is a 24-pp air data file covering engineering and test facilities for propeller fans, specifications, construction, maintenance, and installation. Tables for estimating air-handling requirements, entrance and elbow losses and duct sizes are provided. Also included are specifications for special-use equipment, corrosion-resistance and temperature guides, as well as physical fan laws, terms and definitions. Aerovent Fan Co., Inc.

Do any of these bulletins answer your operating or maintenance needs? Let us know by circling the number of the bulletin on the post card provided on pages 131–132. We'll do the rest!

121 Heavy-Duty Fans — Bulletin MD-102, 24 pp, explains the construction, operations, and specifications of a rugged line of fans designed for heavy industrial and commercial installations. Describes in word and picture detail, the specific applications of this line of aerodynamically designed packaged direct drive units and V-belt fans. Features performance data, as well as dimensions, drawings and practical applications. Chicago Blower Corp.

VALVES, PIPING, FITTINGS

122 Materials For Main Steam Piping — Entitled "The Plastic Ductility of Austenitic Piping Containing Welded Joints At 1200 F," this 16-pp bulletin deals with an investigation into the problem of selection of materials for main steam piping. Gives stress rupture characteristics of type 316 and 347 stainless steel piping adjacent to welded joints. Pittsburgh Piping and Equipment Co.

123 Automatic Valves — Condensed Catalog P & H-57, 12 pp, features company's automatic valves, covering main uses, installation tips and construction features along with specification tables for each series. Cutaway view illustrates design features, and a table gives selection data. A. W. Cash Valve Mfg. Corp.

124 Control Valves — Bulletin HB-6, 8 pp, describes air-operated Saunders patent-type valves. Gives construction details and operating characteristics. Also includes sizing data and a listing of flow co-efficients. Conoflow Corp.

125 Valves, Regulators — This 8-pp catalog covers pressure reducing and regulating, relief, back pressure and control valves; controllers; differential regulators; oil pumping units; governors; combination and temperature regulators. Provides a photo of each unit, with text giving its function, application, construction and range of sizes. Includes examples of complete control systems. A. W. Cash Co.

126 Plumbing, Heating Valves — Bulletin PH58, 16 pp, explains valve requirements of plumbing and heating systems, tells how company's valves meet these requirements, and shows typical installations. Among valves described are air and vacuum radiator venting valves for steam and hot water systems, water mixers, relief valves, flow control valves, others. The Dole Valve Co.

127 Plug Valve Lubrication — Sixteen-pp Section 5A of Reference Book 39 gives lubricant recommendations for nearly 4000 service conditions for which lubricated plug valves can be used. Also shows lubricated plug valve accessories, fittings, automatic lubricators, lubricant guns. Tells how to select and order lubes. Homestead Valve Mfg. Co.

128 Rigid PVC Pipe — Bulletin 557, 12-pp catalog, describes regular and high-impact corrosion-resistant rigid polyvinyl chloride pipe. Includes tables of pipe sizes available, specific chemical applications, physical properties, temperature factors for various working pressures, support spacing and thermal expansion. Flow charts, installation instructions, pipe characteristics and applications are given. Alpha Plastics Inc.

129 PVC Fittings, Flanges — Technical data and installation information on unplasticized polyvinyl chloride pipe are provided in this 24-pp booklet. Also gives specifications for threaded and socket types of PVC fittings, valves and flanges, of normal and high-impact material. Contains pressure-temperature charts, chemical resistance tables, support spacing formulas. Tube Turns Plastics, Inc.

WELDING

130 Welding Guide — Now in its fifth printing, this 40-pp pocket-size booklet is a handy, on-the-job reference for all types of welding with manufacturer's electrodes and gas rods. It tells what rod to use for the job, how to use the rod, what amperage to use, plus hardness and chemical content of the rod. Also includes a cause-and-solution trouble chart, table of steel hardness numbers, and a rod comparison chart. Marquette Mfg. Co., Inc.

131 Hard Surfacing Electrodes — A line of electrodes suited to hundreds of hard surfacing applications are described in 20-pp Catalog HS-56. Important information is also furnished on how to decrease porosity, cracking, penetration and weld metal dilution with these low hydrogen electrodes. Physical and chemical properties of typical deposits for 16 electrodes charted. Metal & Thermit Corp.

BOILERS, HEAT EXCHANGERS

132 Automatic Boilers — Bulletin 1245, 24 pp, details advantages of company's packaged automatic boilers which provide low-cost steam for heating and processing. Illustrations of both oil and gas fired units are included, along with details on components. Features, tabulated dimensions, weights and ratings for the various models are given. Orr & Sembower, Inc.

133 Two-Drum Boilers — Bulletin SB-58, 12 pp, describes company's two-drum boilers, which provide high capacity in a compact design that saves space and lowers installation and maintenance costs. Delineates improved features and gives design, construction and application information. Erie City Iron Works.

134 On Heat Exchangers — One of two 6-pp bulletins, TE-1, on company's heat exchangers and heat recovery equipment, describes a heat recovery system for utilizing heat contained in waste process liquids in the textile industry. The other bulletin, HE-1, covers removable tube bundle type and fixed tube plate type exchangers. The Sims Co.

135 Heat Exchanger Costs — This 20-pp catalog contains design and cost comparison data on heat exchangers using company's integral low-finned tubing. Presents an analysis of the comparable costs between plain condenser tube and low-finned shell and tube exchanger. Wolverine Tube, Div. Calumet & Hecla, Inc.

WATER TREATING

137 Carryover Solution — Technical Paper 136, is a case history of carryover at a paper plant. It points up fact that physical condition of a boiler is also important when steam conductivity goes up. Betz Laboratories, Inc.

138 Cooling Water Treatment — Technical Paper 137, 6 pp, discusses problems of corrosion and tower wood deterioration encountered in recirculation cooling water systems. Tells how concurrent presence of these problems in one plant resulted in plugging of heat exchanger tubes and in high metal loss throughout system. Describes treatment undertaken both to minimize attack of wood and to prevent corrosion. Betz Laboratories, Inc.

MECHANICAL POWER TRANSMISSION

139 Transmission Products — Catalog 914, 88 pp, features company's transmission products and their uses in elevating and conveying machinery. Descriptive information with drawings and tables of dimensions covers shaft collars, coupling, clutches, pillow blocks take-ups wheel hubs, gears, holdbacks, chains and sprocket wheels. The Jeffrey Mfg. Co.

140 For Power Transmission — Bulletin A-646A, 8 pp, contains data on company's power transmission machinery, including sheaves, sprockets, bushings, conveyor pulleys, couplings, speed reducers, clutches, bearings, take-ups, V-belts, collars, and steel transmission pulleys. One page is devoted to Flexidyne, a dry fluid drive and its advantages. Dodge Mfg. Co.

141 Oilless Bearings — Catalog 240, 24 pp, includes specifications, sizes, and operating characteristics of standard conveyor roll bearings as well as self-sealing, free draining and conical bearings for use on various types of conveyors. Non-contaminating and abrasion resistant screw conveyor hanger bearings are detailed in a section which includes installation and dimensional data. Tables covering speed and load values, tolerances, and clearances included. Arguto Oilless Bearing Co.

142 Bearing Manual — Included in the 88-pp 15th edition of company's general catalog and engineering manual is a section correlating anti-friction Bearing Manufacturers Ass'n terminology with company's designs. Other sections deal with selection of ball thrust bearings; calculating thrust load capacities for any speed; effect of parallelism and flatness; fits and tolerances; formulas for calculating thrust loads for various gear drives; oil and grease lubrication methods; grease selection guide; and handling of bearings. Complete specifications are given on manufacturer's basic products, including ball thrust bearings, washers and retainers, mounted radial bearing units, roller bearings. Aetna Ball & Roller Bearing Co.

143 Dry Fluid Drive — Bulletin A-654 describes a larger size Flexidyne drive and coupling, and includes photos, drawings and tables listing various motor sizes with which this dry fluid drive may be used. Specifies recommended flow charges for horsepower ratings at various motor speeds and gives other engineering data. Dodge Mfg. Corp.

144 Flexible Couplings — Included in 8-pp Catalog 7 is information on company's new taper-bushed flexible coupling. Charts show horsepower ratings, dimensions, maximum rpm and other engineering data pertinent to selection of correct coupling. Diamond Chain Co., Inc.

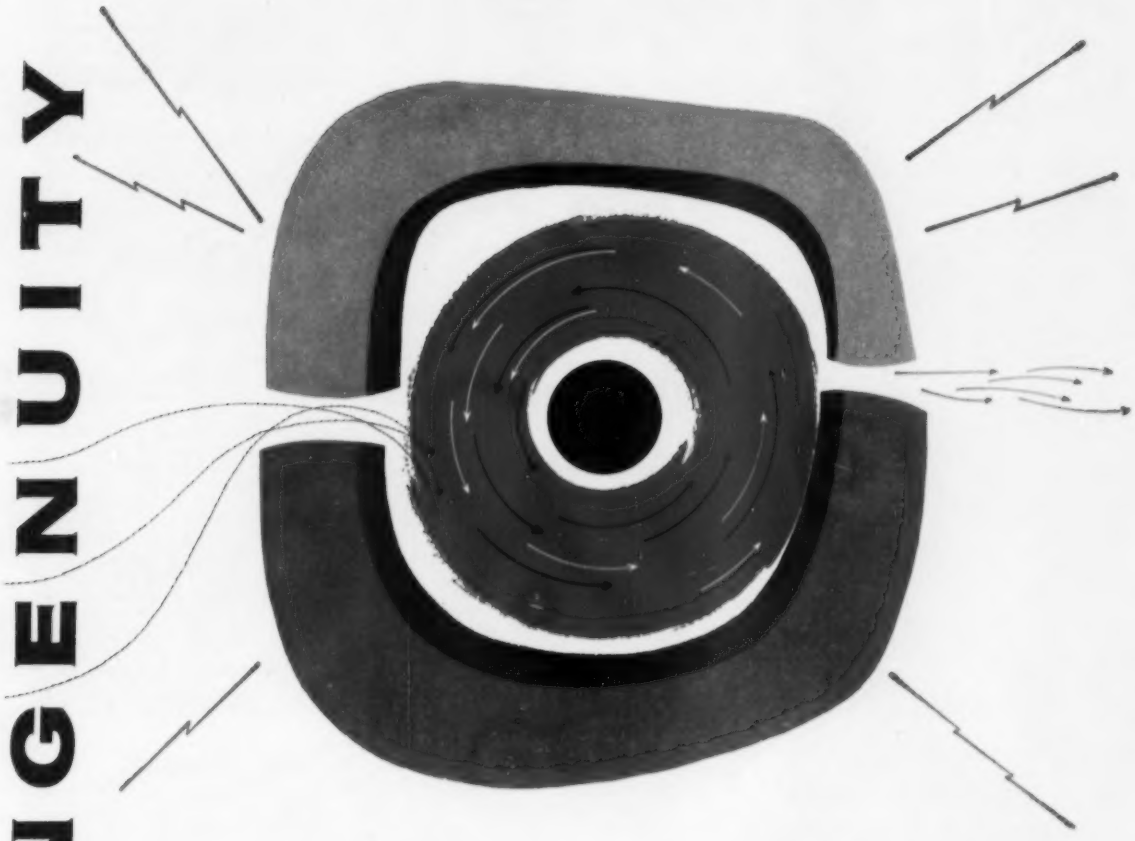
DUST CONTROL

145 For Dust Control — Sixteen-pp Bulletin 274B describes company's Type W Roto-Clone, a dynamic precipitator. Discusses its operation, covering various arrangements. Explains unit's distinguishing feature — addition of a water spray to basic principle of dynamic precipitations. Also included are wiring diagrams, performance tables, exploded view of shaft assembly, water supply rate tables, shipping and operating weights, other data. American Air Filter Co., Inc.

146 For Wet-Type Collectors — Hard deposits, congestion and corrosion greatly decrease efficiency of wet-type dust collectors and necessitate frequent cleanouts. Bulletin WDC shows how proper water treatment will reduce these

call KE for plant expansion or new facilities

INGENUITY



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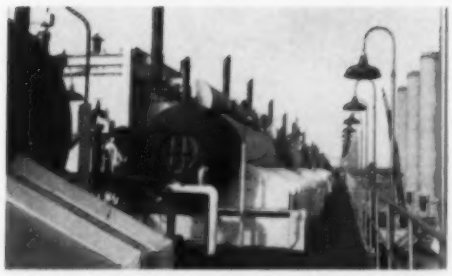

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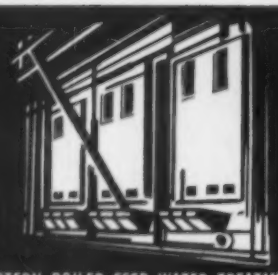
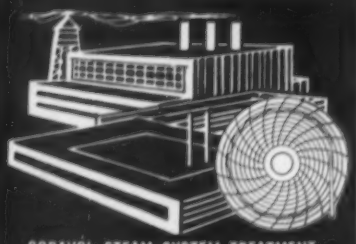
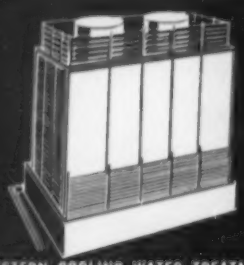


WESTERN BOILER FEED WATER TREATMENT



CORAVOL STEAM SYSTEM TREATMENT



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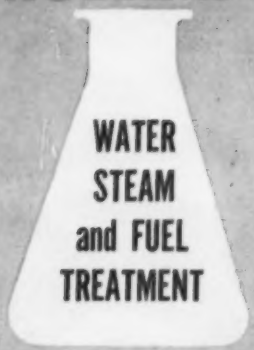
SOLVE your PROBLEMS of



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faults and promote peak efficiency. The North American Mogul Products Co.

147 Air Distributing Units — Electronic air cleaner sections for company's air distributing units are described in this illustrated bulletin. Three dimensional view of component parts folds out to reveal fan section, cooling section, heating coil and precipitron, along with descriptive details on each. Westinghouse Electric Corp.

148 For Air Cleaning — Company's new Precipitron models PA and PF air cleaning equipment are discussed in 8-pp Bulletin B-1460. Contains pictures, descriptive text and capacity-dimension charts. Advantages and construction features are discussed in detail. Sturtevant Div., Westinghouse Electric Corp.

METALS

149 Electrical Steel Data — Rev. Blue Data Sheet (Edition 6), 20 pp, gives detailed information on company's Electrical Steel 4750, an iron-nickel steel. Typical physical, mechanical and magnetic properties are given, and 16 graphs included. Allegheny Ludlum Steel Corp.

150 Resistor Alloy — Eight-pp Catalog M-56C-N describes an improved copper-nickel resistance alloy developed for use on "cold" resistor applications in electronic devices, precision instruments and similar apparatus where mechanical stability and a known low coefficient of resistance are required. Contains complete specifications and price information, as well as a comparison of physical properties, tables giving ohms-per-foot and feet-per-pound. Hoskins Mfg. Co.

COAL HANDLING

151 Bulk Storage — BCR Aid To Industry 500–830 describes a bulk-storage bin-discharge device that unloads coal or other bulk solids from bins without arching, ratholing, or funneling. Cross-sectional diagrams are included. Bituminous Coal Research, Inc.

152 Coal Crushers — Advantages of reversible "double-action" hammermills are stressed in 8-pp illustrated Bulletin 726. Also describes rotating ring and swing hammer crushers for low-cost crushing of larger coal or when a coarse size product is wanted, and rigid hammer coal crushers for economical handling of frozen coal at the hopper. Williams Patent Crusher and Pulverizer Co., Inc.

CORROSION PROTECTION

153 On Cathodic Protection — This 16-pp handbook covers the fundamentals, applications and economics of cathodic protection. Among subjects treated are field measurements, condensers and heat exchangers, underground pipe lines, marine equipment protection. Drawings, photos and graphs supplement text. The Dow Chemical Co.

154 Solving Corrosion Problems — Documented case histories of the use of polyethylene as a chemically inert replacement for metal, rubber and other anti-corrosion materials highlight this 19-pp booklet. Describes successful solutions to troublesome corrosion problems and gives actual savings effected on installation and maintenance costs. Mechanical, thermal and electrical properties of Argo-170

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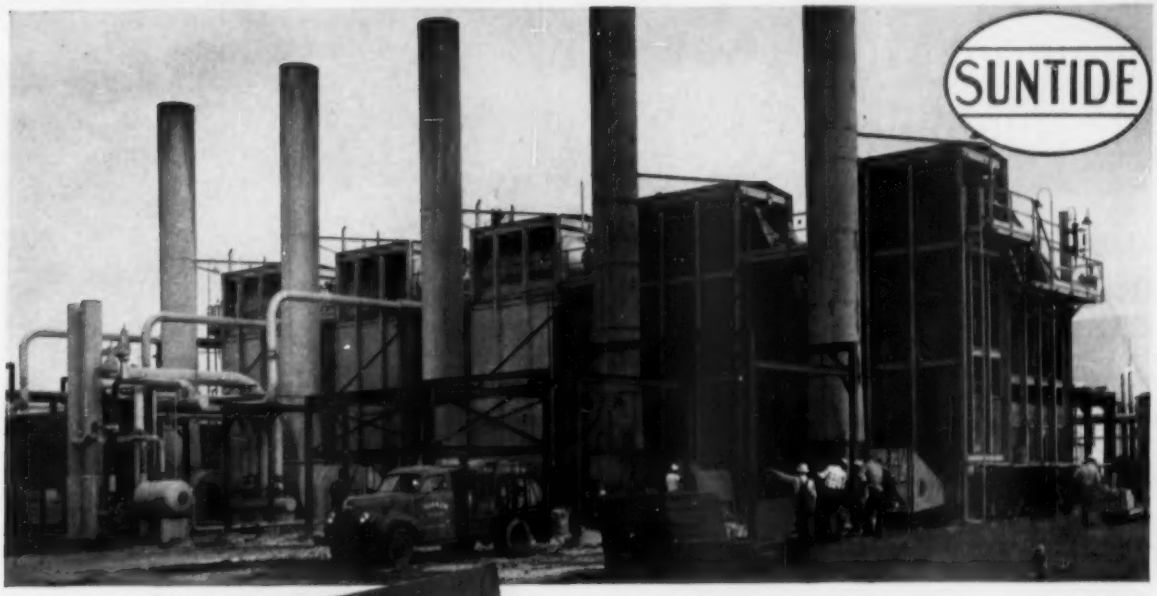

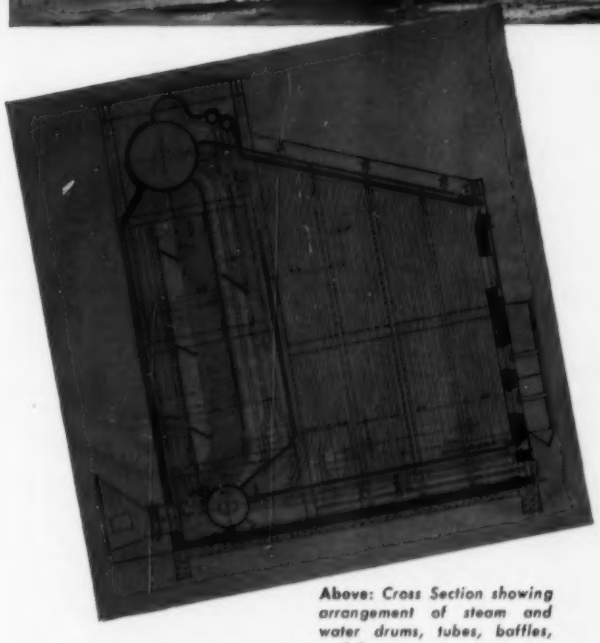

Above: Cross Section showing arrangement of steam and water drums, tubes, baffles, and furnace.

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polyethylene are presented in tabulated form and a list of applications provided. Argo Plastic Products Co.

155 Corrosion-Resistant Seals — Eight-pp Bulletin 938 describes corrosion-resistant seals and stuffing boxes for E, P, and R series vessels, stressing their interchangeability. Discusses five conditions to be considered in selecting best way to close opening between agitator and top of reactor. The Pfaudler Co.

. . . Outstanding Among This Month's Catalogs

156 Hydraulic Turbines — Bulletin 02 B 7301A, 48 pp, describes three principle types of hydraulic turbines, including some large installations in each category with cross sections and other engineering information. Illustrated reference is made to such projects as Kemano, Noxon Rapids, Shepaug, St. Lawrence, and Hiwassee. A section on the reversible pump-turbine, a major contribution to water power development, and on impulse turbines, including vertical multi-jet units, is also given. Allis-Chalmers Mfg. Co.

157 Power Reactor Systems — Bulletin GER-1384, 28 pp, reviews reactor systems for producing commercially useful electricity from nuclear energy. Basic functions of the nuclear power reactor system are covered and detailed information on various systems using water, gas, sodium and liquid-fuel as coolants is presented, profusely illustrated with diagrams and drawings. General Electric Co.

158 Drafting Timesavers — Contained in this 40-pp booklet are 59 shortcuts to speed drafting and computation, offering new approaches to old problems. A section on calculating ideas give tips including ways of remembering signs of trig functions, dividing a circle into parts, etc. Some drafting shortcuts are presented and an engineering data section gives practical shortcuts to formulas. Also provided are drawing board timesavers, including faster methods of determining gear inertia and interpolating between family of curves. Frederick Post Co.

159 Feedwater Heaters — Sixteen-pp Bulletin 300 outlines use of feedwater heaters, their economies and design problems. Also discusses some present-day trends in power-plant equipment. Vertical and horizontal types of installation are described, as are six functional designs: straight condensing; condensing and desuperheating; condensing and short subcooling; condensing and long subcooling; and condensing, desuperheating, and long subcooling. Types S and L heads are discussed. Also treated are tube joint fabricating methods and advantages of roller expanding and welding. The Griscom-Russell Co.

OTHER EQUIPMENT

160 Floor Gratings — Advantages and characteristics of three types of grating construction are detailed in this 16-pp catalog. Various types of gratings are illustrated and described, and safe load tables are included. Steel safety steps, aluminum

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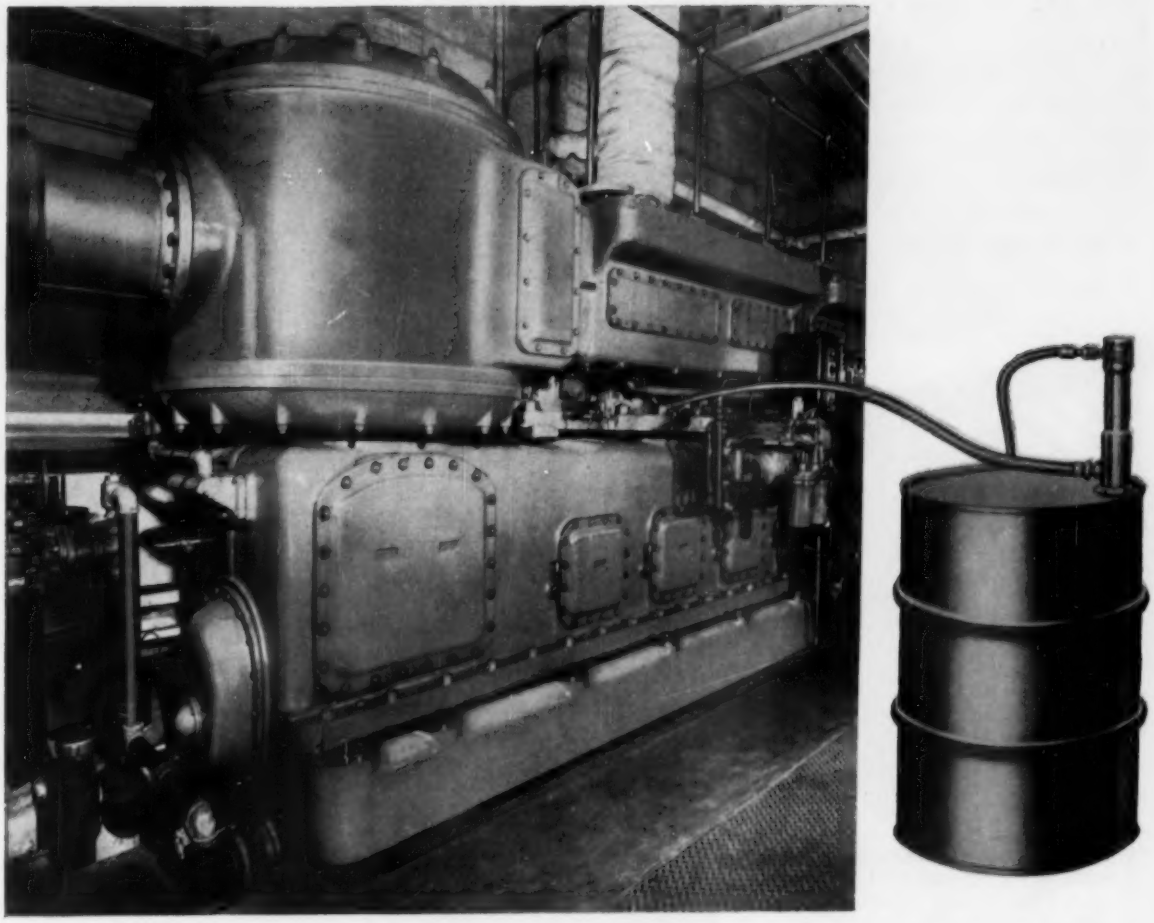

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★ No sharp edges to damage cables
★ Complete interchangeability

Now, for the first time, two types of cable trays, one a ladder type and the other a basket type, are available to be used INTERCHANGEABLY at any given location, depending on the type and weight of the cables to be suspended. The advantages of each type tray can thus be used to the fullest extent. Globetray, the ladder type, is intended for use where festooning is not a problem, while Cable-Strut, the basket type, is intended for the support of communication wire, instrument tubing and control cables in automation applications.

These two cable trays have been thoroughly field tested in hundreds of large industrial installations, in new plant construction, in power plants, in modernization, and for power distribution in all types of manufacturing processes. A new catalog, just off the press, gives full information and installation techniques. Ask for your FREE copy today.

Distributors are to be found in all principal cities—consult the yellow pages in your phone book under "Gratings" or "Conduits" for the one nearest you.

109

PRODUCTS DIVISION

The **GLOBE** *Company* MANUFACTURERS SINCE 1914

4022 SOUTH PRINCETON AVENUE, CHICAGO 9, ILLINOIS

For more data circle 520 on Post Card

floor gratings, steel floor armor, steel roadway gratings, and sidewalk slabs are also covered. Borden Metal Products Co.

161 Industrial Hose Reels — This 16-pp catalog describes company's diversified line of hose reels for industrial applications. Completely illustrated with photos and cutaway views, it provides detailed information on design and construction features, and contains tabulated specifications. Standard reels described include those for handling of liquids and gases, cable reels, and reels for storage of rope and wire. Clifford B. Hannay & Son, Inc.

162 Residual Fuel Purification — This 20-pp technical report discusses the problems encountered and the progress made in developing improved methods and equipment for the continuous centrifugal purification of heavy residual oils for diesel engine fuel. Also describes operation of company's self-cleaning recycle system which eliminates shut-downs for centrifuge bowl cleaning. The Sharples Corp.

163 Storage Tank Heaters — Supplement 202A, 8 pp, contains hook-ups of electric heaters and heat-requirement nomographs for storage tanks handling viscous fluids. Fluids covered include fuel oil, asphalt, road oils, molasses, tallow, animal fats, sodium and sulphur. Hook-up schematics and installation photos show how heaters can be installed in storage tanks of different sizes, types and services. Hynes Electric Heating Div., Turbine Equipment Co.

164 Stationary Diesels — Twelve-pp Bulletin 110 describes company's stationary diesels, designed to provide low speed power for continuous, heavy-duty service. Includes product photos, illustrated construction features, dimension data, performance curves, and specifications. White Diesel Engine Div., The White Motor Co.

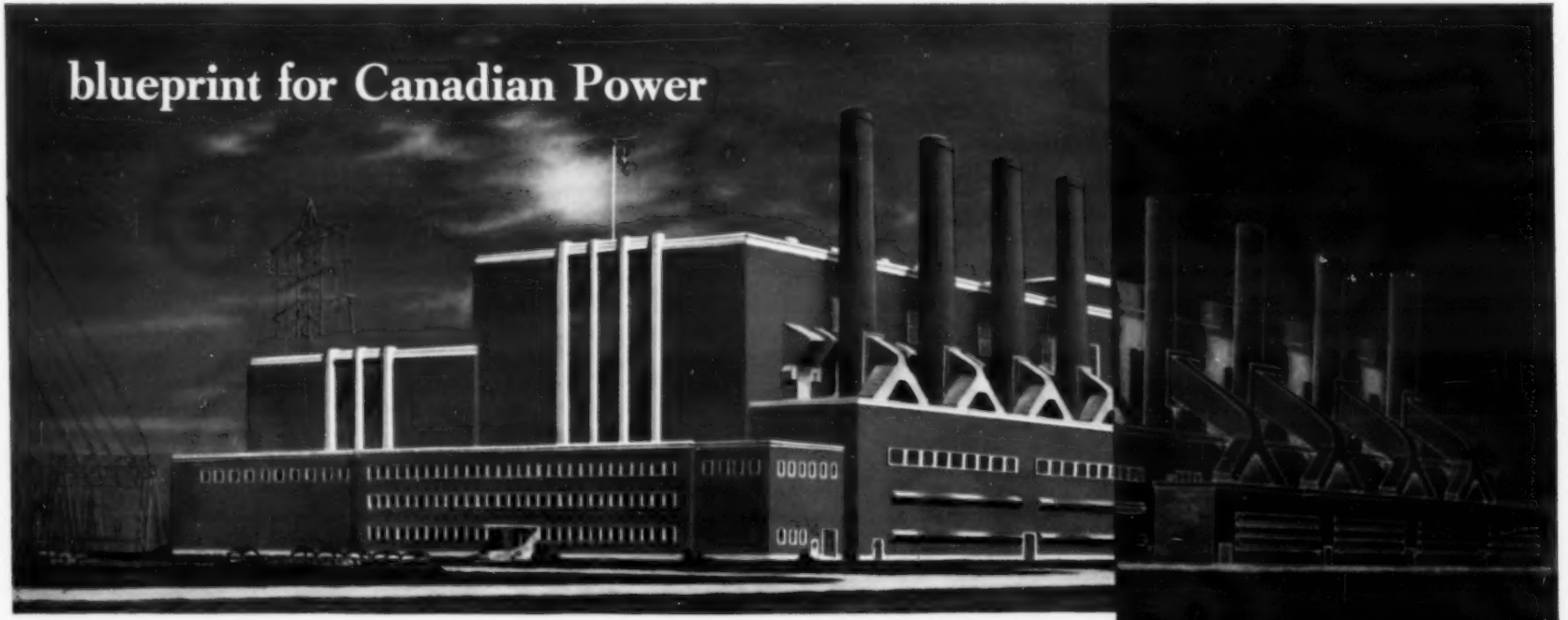
165 Surface Condensers — General, construction and operation features of company's line of surface condensers are described in Bulletin M-571. A cutaway view shows component features. Southwestern Engineering Co.

New and revised publications reviewed on these pages offer help on operating and maintenance problems. To order, use the handy Reader Service Cards provided on pages 131 and 132.

166 Safety Equipment — Catalog 10, 48 pp, presents company's entire line of safety equipment in an easy-to-use buyers'-guide arrangement. Catalog includes all types of protective equipment — from a small dust mask to a large barrel lifter. Profusely illustrated, it gives specifications and recommended use, grouped according to function for convenience. General Scientific Equipment Co.

167 Fastener Sealant — Technical Report 5, 12 pp, tells how to lock threaded fasteners with Loctite sealant. Selection of grade is outlined and specific uses and methods of application are documented for studs, screws, nuts, and other threaded products. Techniques for sealing and soldering sleeve joints are covered, as well as formulas for torque determination under varying conditions, and physical properties of the material. American Sealants Co.

blueprint for Canadian Power



Ontario Hydro's Richard L. Hearn Generating Station in Toronto went on the line in 1951 with 100,000 kilowatts. By 1960 it will be generating 1,200,000 kilowatts . . . an average increase of over 100,000 kilowatts a year! When completed, the Hearn Station will be Canada's largest thermal generating facility.

The Hydro-Electric Power Commission of Ontario awarded the design and construction of the original unit and all subsequent additions to Stone & Webster.

In Canada, in the United States, all over the free world Stone & Webster Engineering Corporation and its affiliates are providing on-the-spot engineering services to many industries. And as a completely integrated organization Stone & Webster can handle a single engineering phase or take full responsibility for the completion of a major project including Design, Construction, Consulting Engineering, Reports, Appraisals and Examinations.

Write or call us for information as to how our experience may be of assistance to you.

1952—Second 100,000 kw unit went on the line.

1953 — Two additional 100,000 kw units placed in operation.

1960—Four 200,000 kw units scheduled for completion.

STONE & WEBSTER ENGINEERING CORPORATION

A SUBSIDIARY *of* STONE & WEBSTER, INC.

New York Boston Chicago Pittsburgh Houston Los Angeles San Francisco Seattle Toronto

CONSOLIDATED "ELECTROMATIC" RELIEF VALVE

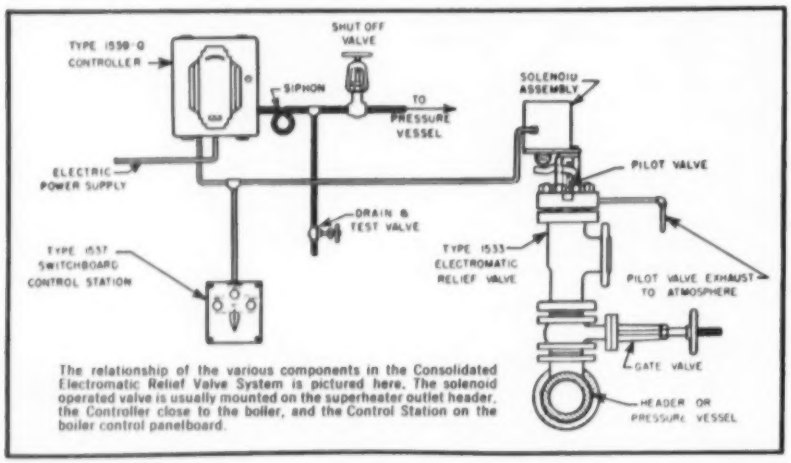
REDUCES POSSIBILITY OF SUPERHEATER DAMAGE

IN H-P, H-T BOILER START-UPS

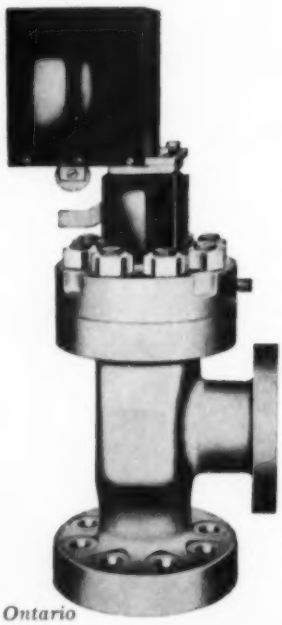
The Electromatic is an automatic relief valve widely used to purge superheaters to obtain faster start-ups or to serve as a superheater surge vent valve. It greatly minimizes the possibility of burning out the superheater elements when firing up a cold steam generator or a banked boiler – saves both fuel and pure water.

The valve is operated by a solenoid actuated by a control station on the panelboard. Merely setting the switch provides automatic or manual service or cuts the valve out of operation. Pressures are relieved precisely within close limits with "quick as a wink" cyclic action. The valve can be set for a differential as low as 1% between opening and closing pressures. High superheat temperatures or other variables do not affect valve operation. A constant maximum pressure output is maintained on the superheaters.

The Electromatic is the ideal auxiliary valve for steam generating plants with pressures to 3000 psi and temperatures to 1120° F. As an auxiliary, it becomes the "working" valve, saving "wear and tear" on the spring-loaded safety valves and reducing substantially the chances of damage to other costly equipment. At the same time power is conserved, plant efficiency is increased and less maintenance is required. The Consolidated Electromatic Relief Valve is available in 2½", 4", 10" and 14" sizes. Get complete specifications and operational details. Send for Bulletin 720.



The relationship of the various components in the Consolidated Electromatic Relief Valve System is pictured here. The solenoid operated valve is usually mounted on the superheater outlet header, the Controller close to the boiler, and the Control Station on the boiler control panelboard.



In Canada: *Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario*

CONSOLIDATED SAFETY VALVES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONN.

MAKERS OF 'AMERICAN' INDUSTRIAL INSTRUMENTS, 'ASHCROFT' GAUGES, 'CONSOLIDATED' SAFETY VALVES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, *Stratford, Conn.* 'HANCOCK' VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Okla.* AIRCRAFT CONTROL PRODUCTS, *Danbury, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*

For more data circle 522 on Post Card

Hall Industrial Water Report

VOLUME 5 OCTOBER 1957 NUMBER 5

Waste Is Waste

In some cases, waste water is truly just "waste" and must be disposed of in the least costly manner; in others, waste water may contain valuable materials, so that failure to recover these before discarding the water is "waste" in a different sense.

Specialized knowledge and experience are necessary to search effectively for the economical changes which can be made in a plant to minimize loss of valuable materials, to confine pollution to the smallest volume of waste water, to decide what treating procedures should be used and what control should be exercised. Hall staff engineers and industry specialists have the training and experience required and are ready to tackle your problems.

Who Muddied the Waters

A mid-western tire plant wished to reduce or eliminate pollution of waste water. As a first step, a plant survey was made by Hall Staff Engineer E. G. Paulson.

This survey narrowed the major source of waste water contamination to several plant operations. The next step involved gauging, sampling and analytical work on the plant effluent and on inplant waters. This established that the primary contaminant was suspended solids, presumably from a process where clay slurry was sprayed on an intermediate product. However, material balance calculations disclosed a major discrepancy between estimated clay pollution and actual suspended solids concentration of the waste water.

The third step was a resurvey to definitely identify the suspended solids as clay and to confirm the high concentration in the waste water. The outcome was that the suspended material was almost all clay, that clay was used in only one section of the plant and that the amount of clay getting into the plant effluent was greater than had been estimated.

This case is a good example of how stepwise approach to a pollution problem can pay dividends. Plant engineers and Hall personnel changed the process for applying the clay slurry and another survey showed that the pollution loading was reduced by more than 85 percent. The cost of making the changes will be recovered in 18 months by the saving in process material.

Whittling Away at Waste

More than ten years ago an eastern detinning plant contracted with Hall Laboratories for a long-range program to eliminate objectionable contamination of waste water in the most economical and satisfactory manner.

Initial studies on the sanitary and process water systems were made to determine the pollution load. One of the first results was segregation of the sanitary sewage and its discharge to a municipal sewage system.

The remaining waste water came from seven different locations in the plant.

Continuing study showed three streams to be uncontaminated and one stream to be contaminated only periodically. Investigation was extended to determine whether water could be recycled and whether the volume of polluted water could be decreased.

After inplant changes were made to segregate uncontaminated water from polluted water, there remained three polluted streams, one flowing rinse and two batch dumps. Joint efforts of the plant's research department and Hall Laboratories resulted in development of methods for treating the contaminated waters. An economic study showed that with properly designed treating equipment almost $400 per day could be saved by recovery of valuable materials. This was over and above the operating cost and depreciation on the new equipment.

A more efficient reclamation process eliminated two of the three polluted streams and left one very heavily contaminated batch dump. With only one polluted water stream requiring treatment and with the method of treatment already determined, the problem has been whittled down to a simple answer. This is an excellent example of what can be accomplished by cooperation between plant personnel and Hall engineers.

From Shortage to Abundance

An eastern electrical products manufacturer faced a serious water supply problem. Expanding operations required more water. The two supply sources, plant wells and city water, were inadequate. The wells were already being pumped to the limit of their capacity and the city wanted to supply less water because of increased domestic requirements.

Hall staff engineers were called in to survey the water situation. They found that city water consumption could be reduced 40 percent by reuse and modification of water use in manufacturing processes. They discovered also that because of the long time required to regain maximum pumping capacity after shutting down, the plant operators were running the well pumps continuously, sending much water to waste during non-working shifts.

Two recommendations were made. One involved the changes necessary to reduce city water consumption and the other was to install storage tanks to collect the well water being wasted. The estimated water saving was close to 500,000 gallons per day.

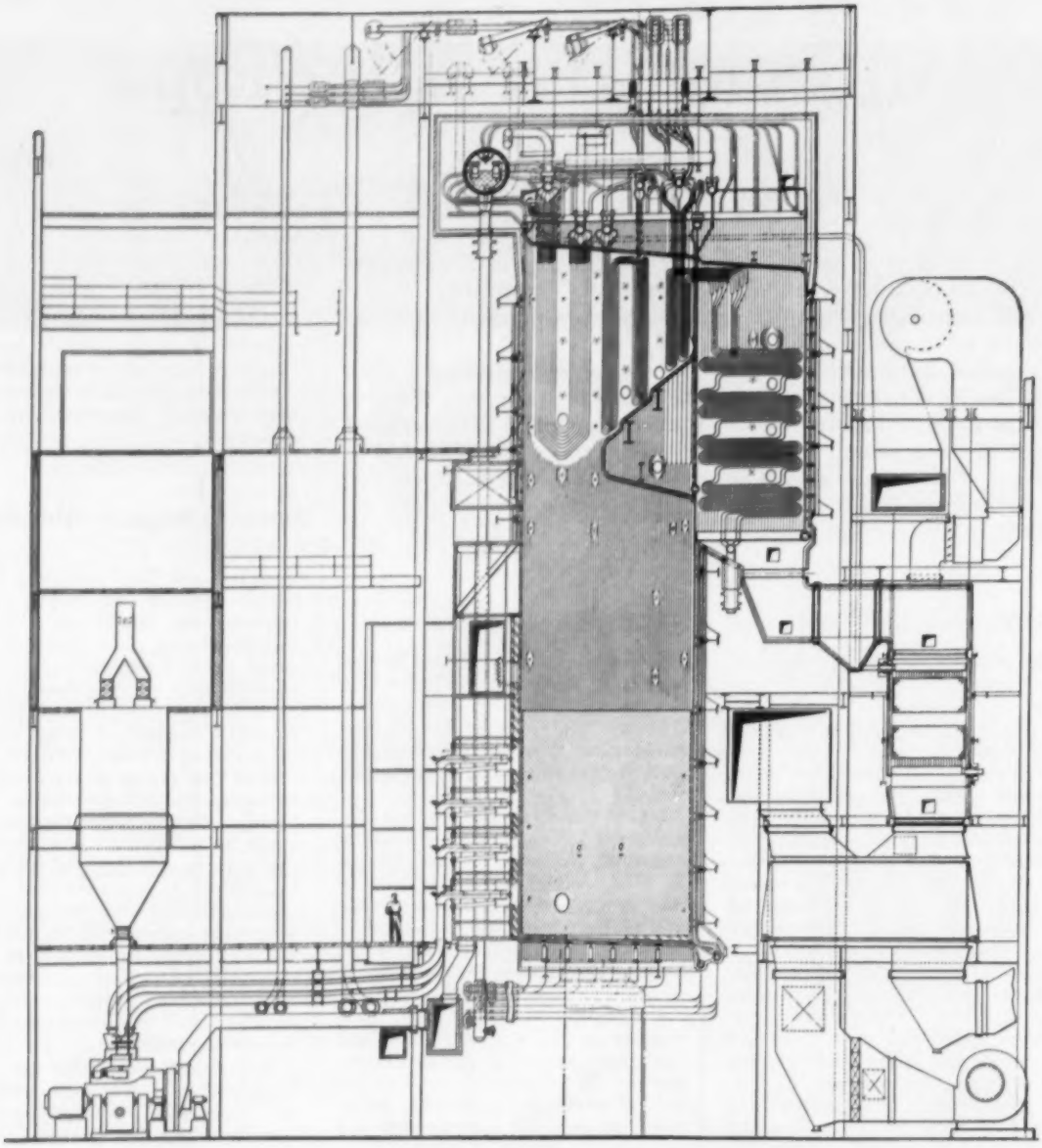
Industrial Water Problems Require Special Handling

There are no "stock answers" to industrial water problems. For information write, wire or call Hall Laboratories, Division of Hagan Chemicals & Controls, Inc., Hagan Building, Pittsburgh 30, Pa.

Water is your industry's most important raw material. Use it wisely.

Hall Laboratories—Consultants on Procurement, Treatment, Use and Disposal of Industrial Water

For more data circle 523 on Post Card



Latest unit for Burlington Station, Public Service Electric & Gas Company has a capacity of 1,350,000 lb of steam per hr. Comprehensive circulation tests on this unit, plus more than a year of sustained performance, proved that natural circulation boilers can operate easily with drum design pressures of 2800 psi, for throttle conditions over 2400 psi.

B&W NATURAL CIRCULATION BOILERS ABOVE 2600 PSI DESIGN PRESSURE

NAME OF UTILITY	STATION	NO. UNITS	DES. PRESS. psi	THROTTLE PRESS. psi	TOTAL TEMP. F	REHEAT TEMP. F	TOTAL KW
Indiana & Michigan Electric Co.	Twin Branch	1	2650	2335	940	900	76,500
Public Service Electric & Gas Co.	Burlington	1	2700	2350	1100	1050	200,000
Public Service Electric & Gas Co.	Linden	1	2700	2350	1100	1050	225,000
Southern California Edison Co.	Huntington Beach	2	2700	2400	1050	1000	400,000
Virginia Electric & Power Co.	Bremo	1	2700	2400	1000	1000	150,000
International General Electric Company	Chiba	1	2700	2400	1060	1010	175,000
Memphis Light, Gas & Water Div.	Thos. H. Allen	3	2825	2400	1053	1053	862,500
Detroit Edison Co.	St. Clair	1	2700	2400	1050	1000	325,000
Virginia Electric & Power Co.	Portsmouth	1	2700	2400	1000	1000	150,000
Southern California Edison Co.	Mandalay	2	2700	2400	1050	1000	400,000
Pacific Gas & Electric Co.	Pittsburg	2	2725	2400	1050	1000	660,000
TOTAL CAPACITY SERVED							3,624,000

If You Are Considering...

2400 PSI THROTTLE CONDITIONS

You'll Want to Investigate B&W's Unique Experience

There's a reason why so many progressive utility companies and their engineers, thinking of turbine throttle conditions of 2400 psi, have turned to B&W. It is the unique record of performance of B&W high pressure natural circulation boilers.

Simplicity of installation and operation has been brought to high pressure steam generation by B&W natural circulation boilers. They have lower operating costs because no machinery requiring power and maintenance is needed for circulation.

Long range operating experience—since 1939—has been gained with natural circulation high pressure boilers operating above 2000 psi. Operators' success with natural circulation boilers is due to the B&W Cyclone Steam Separator, and a design which makes liberal use of outside downcomer capacity and provides proper balance of makeup and riser tubes.

Clean turbines are an extra plus value. Cyclone Steam Separators not only maintain good circulation, but, used with Steam Washers, they maintain exceptionally clean turbines. At one plant, where a B&W Radiant Boiler has been on the line constantly for a year, the turbine manufacturer reports that the turbine is the cleanest high pressure unit his engineers have ever seen. And tubes in the high duty part of the furnace are as clean internally as the day they were installed.

B&W first designed natural circulation boilers for operation at drum pressures over 2000 psi nearly 20 years ago. Today 86 B&W natural circulation boilers with these high design pressures are in operation and 52 more are being built.

The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

O-845-C8

BABCOCK & WILCOX

BOILER DIVISION

For more data circle 524 on Post Card

IMPROVED BLOWER NOZZLE and

more important features of the

New **Diamond** Series 300 IK

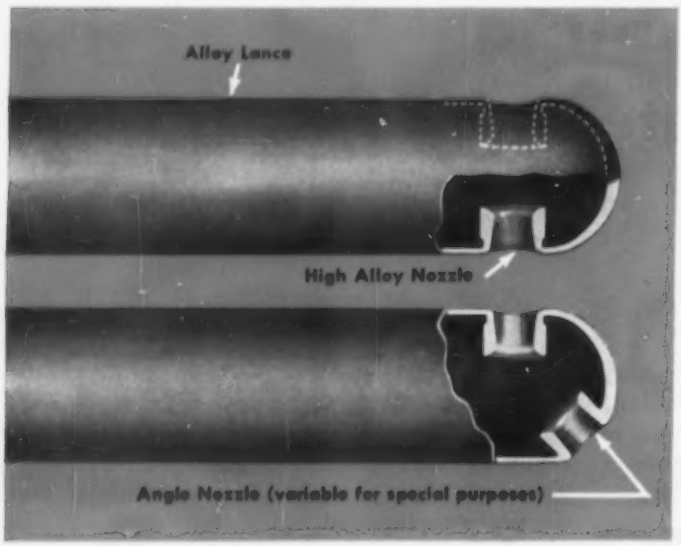
LONG RETRACTING BLOWER

This improved nozzle provides more available cleaning energy per pound of steam or compressed air. A modified venturi, it is the result of extensive research during which more than 50 contours were tested.

The positively-controlled, close helical cleaning pattern assures optimum coverage of the heating surface.

Return travel path is exactly intermediate to forward travel path . . . resulting in a positive nozzle sweep every inch.

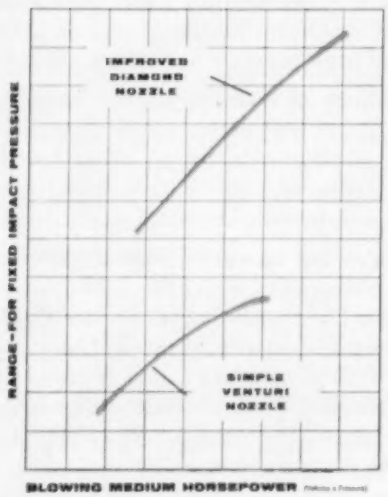
These features are two of many reasons why the Diamond Series 300 IK Blower does a better and more economical job of cleaning surfaces which require a long retracting blower. Other advantages are listed at the bottom of the opposite page. Ask the nearest Diamond office for Bulletin 2111AB which will tell you much more about the new Series 300 IK.



Improved Diamond Type "A" Nozzle has low approach velocity for optimum nozzle performance (see curves below). It provides greatest impact for any given blowing pressure . . . means greater effectiveness and economy.

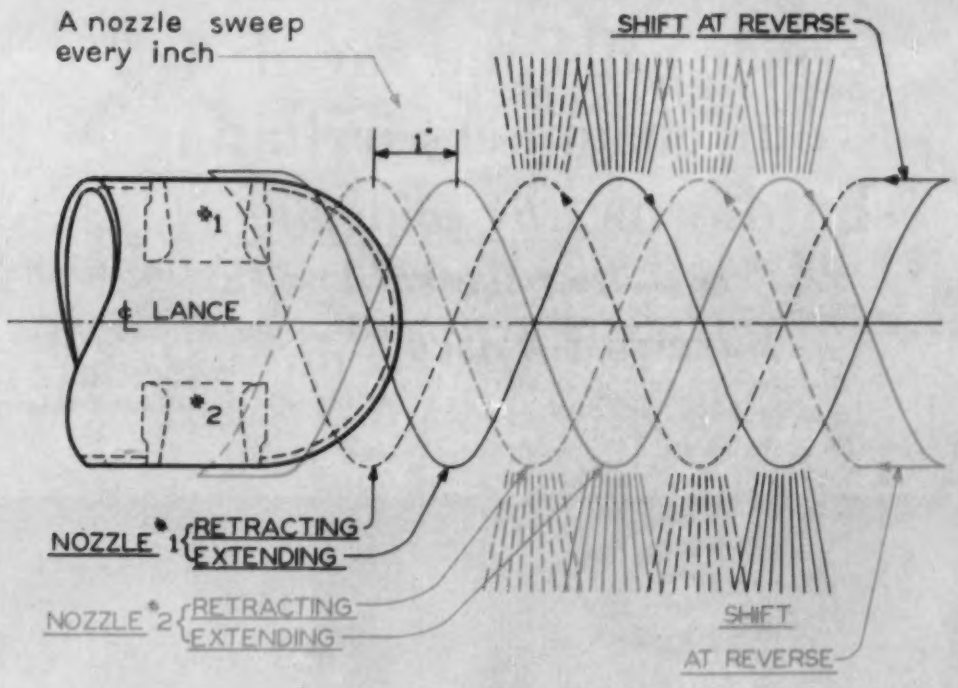
IMPROVED DIAMOND NOZZLE

7818 SIMPLE VENTURI NOZZLE

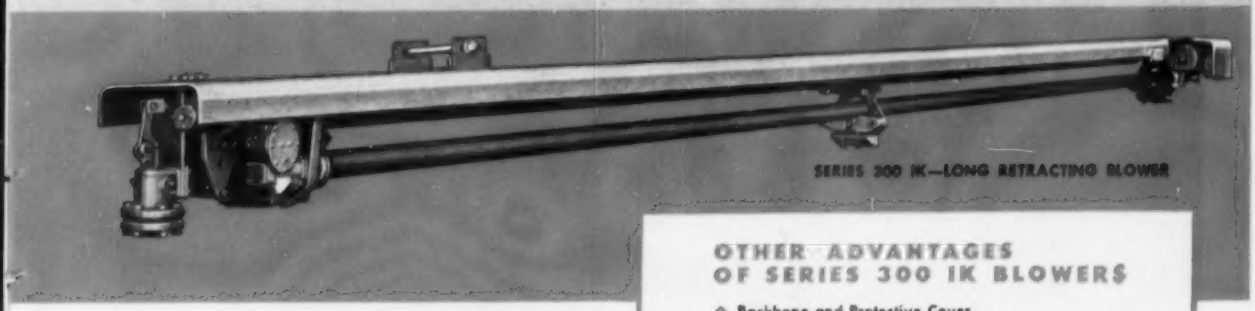


Note the greater blowing range of the improved Diamond Nozzle when compared with a simple venturi nozzle under identical test conditions.

IMPROVED CLEANING PATTERN



Nozzle-sweep-every-inch blowing pattern assures COMPLETE coverage of ALL surface EVERY time



OTHER ADVANTAGES OF SERIES 300 IK BLOWERS

- Backbone and Protective Cover
- Front End Single-Motor Drive
- Compact, Accessible Electric Power and Control Terminal Facilities
- Positive Gear Carriage Drive
- Poppet Valve with Adjustable Pressure Control
- Positive Mechanically Operated Valve
- Single Point Outboard Suspension
- Oversize Lance (Step-Tapered for Extra Long Travel)
- Auxiliary Carriages for Extra Long Travel
- Designed for Quick, Easy Servicing

No other blower gives you all these advantages.

Diamond

DIAMOND POWER SPECIALTY CORPORATION

LANCASTER, OHIO

Diamond Specialty Limited

Windsor, Ontario

For more data circle 525 on Post Card

"We avoided costly service calls and saved our customers irritating shutdowns ..*by equipping welders we sold with Fusetron Fuses*"....

Frank Korinek, OWNER
SUN RAY ELECTRIC COMPANY
CHICAGO, ILL.

Mr. Korinek continues . . .

"About a year ago my motor rewind shop bought 62 welders for resale from a surplus dealer.

"They were 300 ampere arc welders, with the A.C. motor directly connected to a 300 ampere D.C. generator. The motor has a speed of 3500 R.P.M. and a nameplate rating of 56 amperes at 220 volts.

"The welders were equipped with 60 amp., 250 volt fuse clips. However, when we ran the welders in the shop, we found that ordinary 60 amp. fuses would blow on the starting current of the motor.

"We then tried 60 ampere Fusetron dual-element fuses. They proved to hold the starting current and to give the needed protection to the motor and generator.

"We are glad we had this experience in our own shop and installed Fusetron fuses before selling the welders. Otherwise, we would have had a flock of costly unnecessary service calls and run the risk of losing customers.

"As it happens, our customers are satisfied with the performance of the welders and we haven't had a service call or complaint about needless fuse blows."

FUSETRON dual-element FUSES do more than eliminate needless blows. They give 10 point protection not available with any other type of protective device.

AND FUSETRON FUSES REMAIN SAFE THRU THE YEARS . . .

. . . without maintenance and recalibration costs.

Once properly installed, Fusetron fuses require no costly inspection time or maintenance necessary on mechanically operated devices.

Dust, fumes, corrosion or age cannot prevent a Fusetron fuse from opening safely. There are no hinges, pivots or contacts to stick or slow down the operation of the fuse on short-circuits.

When a Fusetron fuse does open to protect, and after the fault has been corrected—the new Fusetron fuse you install has been calibrated at the factory by engineers—it is a fuse as safe and dependable as the one that blew.

DON'T RISK LOSSES! *One needless shutdown . . . one lost motor . . . one destroyed switch or panel . . . one burned out solenoid . . . may cost you far more than replacing every ordinary fuse with Fusetron dual-element fuses. Write for bulletin FIS.*

For loads above 600 amps.—Use BUSS Hi-Cap Fuses to coordinate your electrical circuits.

On 600 volts or less, BUSS Hi-Cap fuses have an interrupting capacity sufficient to handle any fault current regardless of system growth.

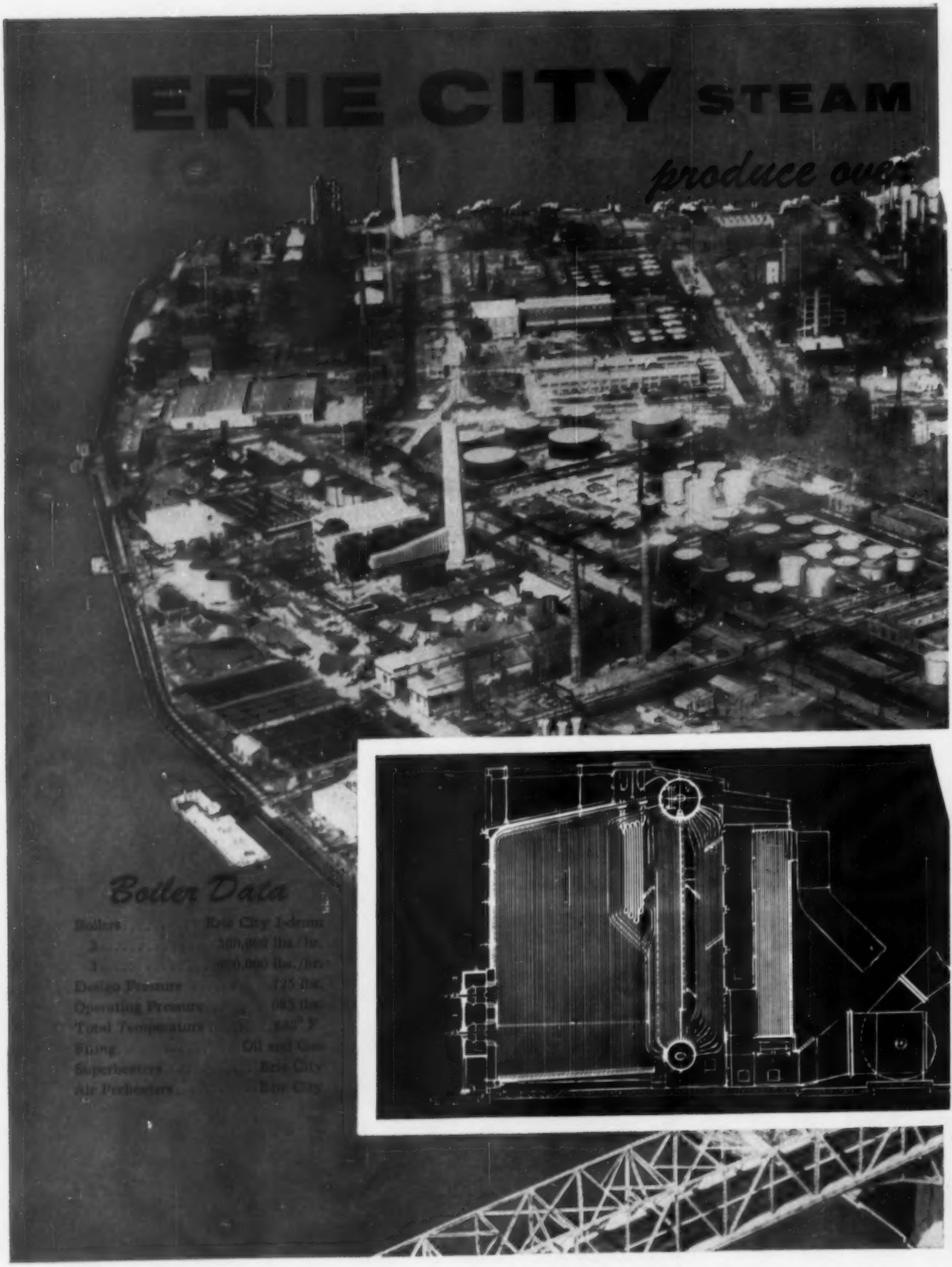
They can be coordinated with Fusetron fuses on feeder and branch circuits to limit fault outages to circuits of origin. Write for bulletin HCS.

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

Bussmann Mfg. Division
McGraw-Edison Co.
University at Jefferson, St. Louis 7, Mo.

Play Safe! Install Fusetron dual-element fuses and BUSS Hi-Cap Fuses throughout entire Electrical System!

For more data circle 526 on Post Card

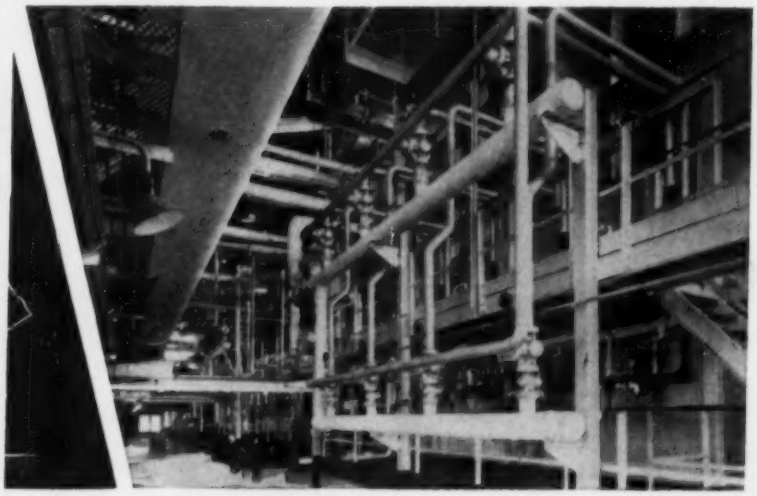

ERIE CITY STEAM
produce ou
Boiler Data
Boilers Erie City 1-drum
2 300,000 lbs./hr.
1 450,000 lbs./hr.
Design Pressure 725 lbs.
Operating Pressure 685 lbs.
Total Temperature 840° F
Firing Oil and Gas
Superheaters Erie City
Air Preheaters Erie City

GENERATORS
2,000,000 #/hr. at GULF
PHILADELPHIA REFINERY

• Another major oil company, Gulf Oil Corporation, liked what they got and came back for more Erie City Steam Generators. In 1951, three 300,000 #/hr. units; in 1953, one 400,000 unit; and in 1956, two 400,000 units — all Erie City 2-drums for outdoor service.

The huge Philadelphia Refinery is an entity unto itself, specifically designed to produce and package Gulf's broad line of high quality petroleum products. Everything about this Gulf operation is tremendous, including some of the world's largest crude Distillation and Catalytic Cracking units. The big Gulf "Cat" alone uses 400,000 lbs. of steam per hour.

Erie City works closely with scores of refineries and petrochemical plants to meet exacting steam specifications. We design and manufacture a complete line of power and waste heat boilers, air heaters, economizers, superheaters, and all types of firing equipment and, therefore, will assume full responsibility for your steam requirements. At no obligation, investigate Erie City for your plant. Write for Catalog SB-503J.



1951

3—Erie City 300,000 #/hr. Steam Generators

1953

1—Erie City 400,000 #/hr. Steam Generator

1956

2—Erie City 400,000 #/hr. Steam Generators

ERIE CITY
117 Years in Steam Generation

You can depend on Erie City for sound engineering

ERIE CITY IRON WORKS • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS

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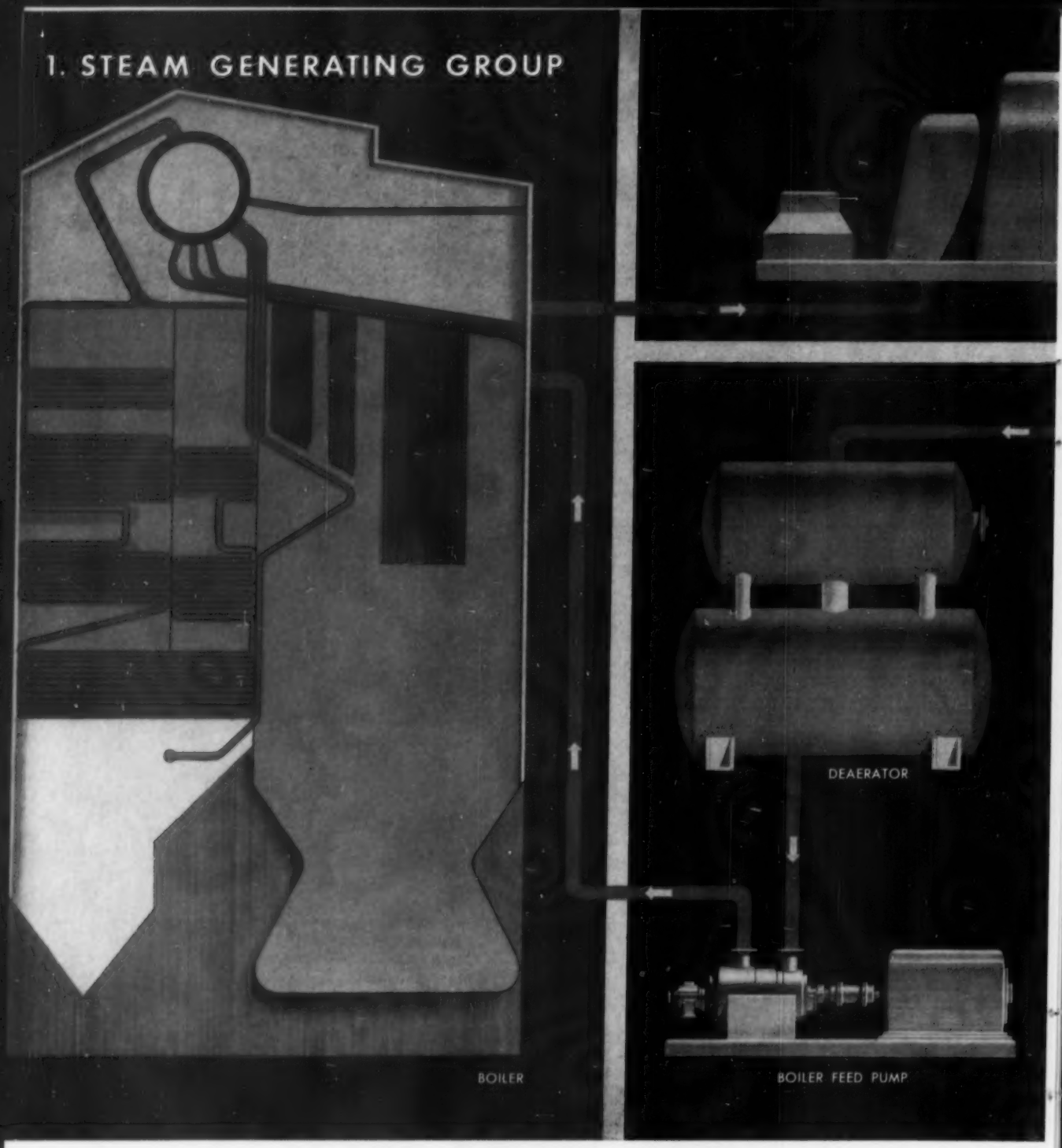
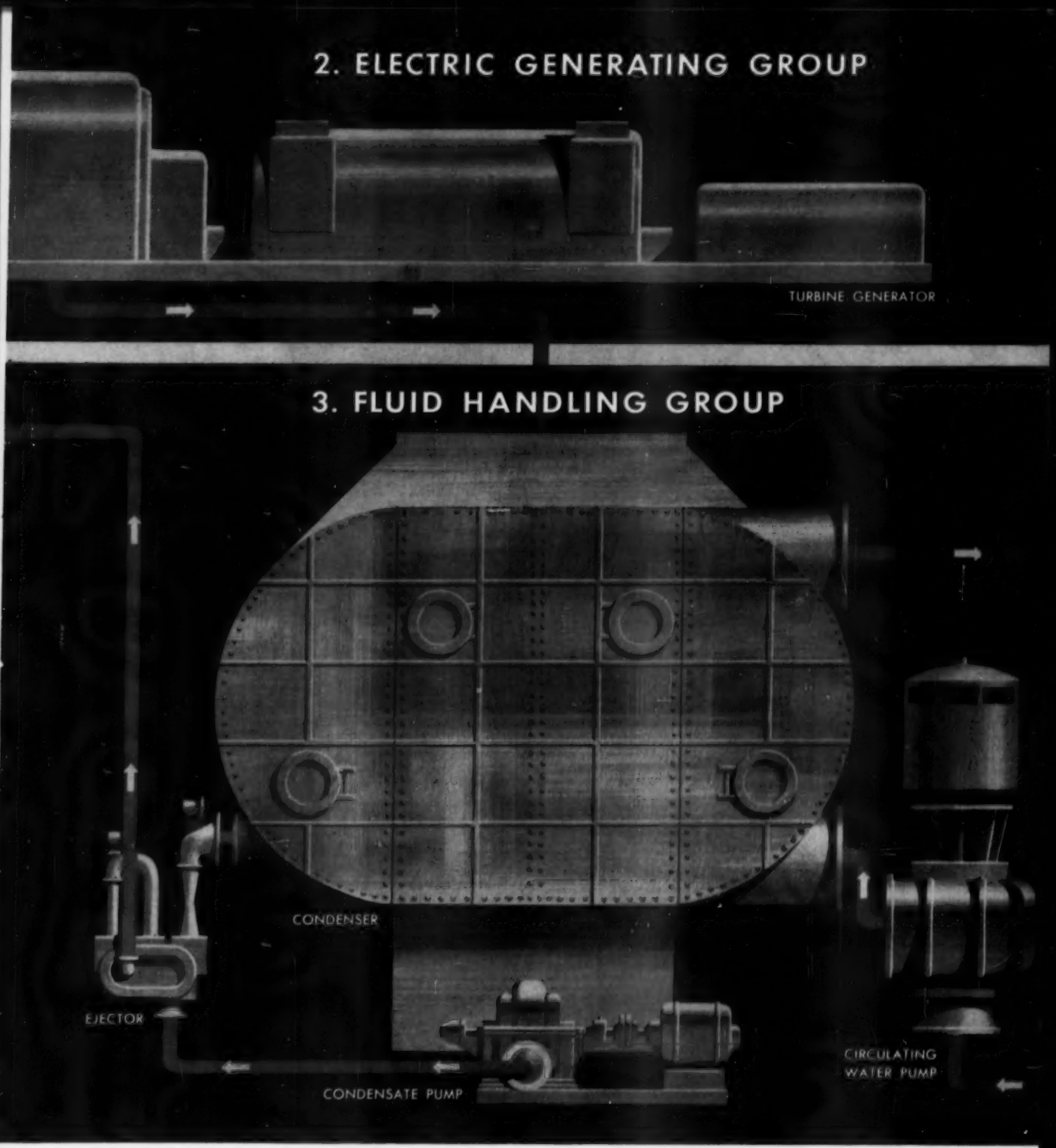


Look at all three

A new steam station design approach is bringing higher efficiencies, lower costs, and greater reliability. In this approach, only three basic functions are considered: (1) Steam Generating, (2) Electric Generating, (3) Fluid Handling. Station requirements are first analyzed in terms of the over-all job performed by each of these groups rather than by each individual piece of equipment.

Many of the benefits of this approach occur in the Fluid Handling Group. Here coordination and integration of the wide variety of equipment used can often effect substantial improvement in over-all operation. As steam temperatures and pressures go up, there are increased demands on the fluid handling function. Plant reliability often depends on the effect of one component of the fluid handling group on another during operational transients, either planned or of emergency nature. The solution is coordinated equipment



for power!

selection, engineering and design. And Worthington's "system" know-how and experience with modern complex plant cycles can help solve your fluid handling problems.

System-wise experience As the manufacturer of all major components of the Fluid Handling Group, Worthington has a reservoir of experience and knowledge that can be of benefit to you. To put this "system-wise" experience to work for you, get in touch with your nearest district office. Or write to section C-71, Worthington Corporation, Harrison, New Jersey.

WORTHINGTON

For more data circle 528 on Post Card

CONSTRUCTION NEWS

Phoenix, Ariz. — Salt River Project Agricultural Improvement and Power District, Maricopa County, Ariz., has arranged financing through the sale of bond issue to total about $5,000,000, majority of proceeds to be used in connection with 1957 expansion and improvement program, along with construction of company's new Aqua Fria Power Station scheduled for completion in late 1958 at an estimated cost of $25,000,000. Plant when completed will have an initial capacity of 200,000 kw.

Burbank, Calif. — City of Burbank has awarded a contract to the Fluor Corp, Los Angeles, to design, engineer and supervise the construction of a 44,000-kw steam-electric generating plant at a cost of between $6,000,000 and $7,000,000. Prior to signing the contract, Burbank's city council had Fluor conduct an extensive study on the power generation and transmission problems facing the community. The survey pointed up the need for additional capacity. Construction will start this fall and the unit is expected to be in operation by early 1959.

San Francisco, Calif. — City of San Francisco and San Francisco County Public Utilities Commission, City Hall, are arranging financing in the form of a bond issue in the amount of $1,300,000, proceeds of which will be used to convert present electrical power station to automatic system.

Tampa, Fla. — Tampa Electric Co, Cass & Tampa Sts, Tampa, Fla., has announced plans for financing and has registered a statement for an $18,000,000 bond and stock issue with the SEC. New money supplied by the twin financing will be used to pay off $22,000,000 in outstanding bank loans and to help finance the company's $23,776,000 1957 construction program for expansion and improvement of existing generating facilities, transmission lines and other work.

Alton, Ill. — Alton Box Board Co, Alton, Ill., has ordered a 12,500-kw steam turbine generator unit, the largest yet for the firm's industrial installation, from General Electric Co's Medium Steam Turbine, Generator and Gear Dept. The turbine, which will drive a 13,529-kva generator to produce electricity for the installation, is adapted for automatic extraction of steam at 160 and 50 psi. The steam will be used for the processing of pulp for box board. Shipment of the unit is scheduled for March 1958.

Indianapolis, Ind. — Public Service Co of Indiana, Inc, 110 N Illinois St, has arranged financing in the sale of bond issue to total about $30,000,000, proceeds of which will be used to pay off short term bank loans and construction expenditures to cover cost of increased generating facilities, power substations, transmission lines and other company improvements.

Baltimore, Md. — Baltimore Gas & Electric Co, Lexington Bldg, has authorized plans for the placing of major equipment orders in connection with the construction of the first unit of new proposed steam electric generating station. Power plant, as yet unnamed, will be built on a recently acquired 138-acre tract of land located about five miles east of here on Carroll Island Road in Baltimore County. At present day estimates, new project will represent an investment in excess of $42,500,000.

Trenton, Mich. — McLouth Steel Corp, 300 S Livernois Ave, Detroit, Mich., has announced plans for a major expansion and improvement program at company's Trenton Works here. Plans call for the expenditure of $35,000,000 for these new facilities which will include a Dravo-Lurgi sintering plant, a major boiler plant expansion, pump house additions and extensions of the river dock and ore storage yard. Work will get under way at once and will be completed by late 1958 or early 1959.

Joplin, Mo. — Empire District Electric Co, 602 Joplin St, has plans under consideration and will arrange financing soon in the amount of $30,000,000 for new facilities over the next six-year period. Company plans improvements and expansions in generating facilities, power substations and transmission lines to better serve the 13 towns in the northeast part of Oklahoma. Company also supplies power for areas in Kansas, Arkansas and Missouri.

Massena, N. Y. — Aluminum Company of America, 1200 Alcoa Bldg, Pittsburgh, Penna., has announced contract awards to the Westinghouse Electric Co, Pittsburgh, covering the delivery of approximately $4,000,000 in electrical equipment to company's Massena plant. Equipment is to be used in a power conversion project as the plant changes over to high-voltage alternating current from the New York State Power Authority's Niagara project. Alcoa at present uses direct current transmitted from plant's own generators situated in a side channel of the St. Lawrence River.

New York, N. Y. — Board of Higher Education, City of New York, 695 Park Ave, has announced plans for the reconstruction of boiler plant and electrical services in Compton Hall, City College. New work will cost an estimated $1,000,000 when completed. William H. Byrne is consulting engineer.

New York, N. Y. — Consolidated Edison Co of New York, Inc, 4 Irving Pl, has announced the purchase of a large parcel of land including buildings on a plot comprising about 30,000 sq ft on which it proposes to construct a large major substation to provide for additional downtown New York City's ever increasing power and electrical demand and future area requirements. New facility will be located at the southeast corner of West Broadway and Franklin St, with a frontage on Leonard St. Project now in its planning stage will probably represent an investment of $500,000.

Syracuse, N. Y. — Niagara Mohawk Power Corp, 300 Erie Blvd, West, has arranged financing through the sale of bond issue in the amount of $50,000,000, proceeds to be used in connection with expansion and rebuilding program of company's generating facilities, power substations, transmission lines and other miscellaneous corporate work.

Painesville, Ohio — City Council, City Hall, has announced plans for the installation of new boiler at municipal power plant. Installation with auxiliary equipment when completed will cost an estimated $1,375,000. H. Ralph Hadlow, Cleveland, Ohio, is consulting engineer.

Portland, Ore. — Portland General Electric Co, 610 SW Broadway, has arranged financing in the amount of $30,000,000, and has concluded a credit agreement with a seven-bank group. Funds will be used to carry on construction program through the balance of this year and through 1958, estimated to be approximately $60,000,000. Work will include expansion of generating facilities, power substations, transmission lines and other work.

Huron, S. D. — Northwestern Public Service Co, has asked the FPC for permission to arrange financing in the form of bond issue in the amount of $1,500,000, proceeds of which will be used to pay off outstanding promissory notes due to company's expansion and improvement program, through 1957.

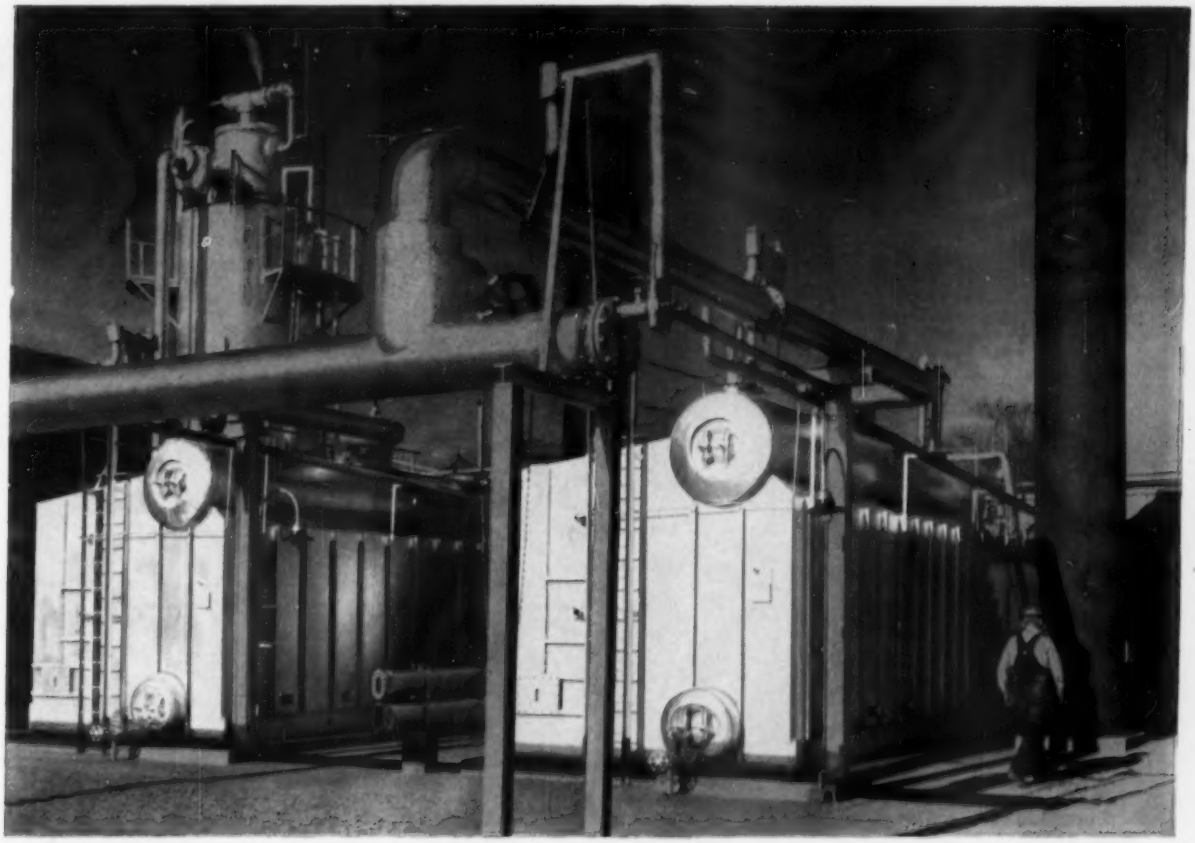
Madison, S. D. — East River Electric Power Coöperative, has announced plans for the installation of a 11,250-kw diesel generating plant, substation improvements and transmission facilities. Company will also construct a 118-mile 69-kv and 34.5-kv transmission line in Minnehaha County. Project when completed will represent an investment of $4,720,000. Ulteig Engineering Corp, consulting engineers.

Baytown, Tex. — United Rubber & Chemical Co, Baytown, has authorized a major expansion program for the improvement and modernization of synthetic rubber plant at Wooster, Tex. Project reported to cost in excess of $15,000,000, will comprise several concrete and metal buildings with equipment and appurtenances. Expansion and improvement of company power plant and transmission lines is also planned at a reported cost of $400,000. Zimmerman Inc, consulting engineer.

Temple, Tex. — Scott & White Memorial Hospital, c/o Dr. P. M. Bassel, President of the Board of Trustees, has announced plans for the construction of new hospital facilities at southeast edge of the city. Project reported to be a multi-million dollar investment will include a $500,000 laundry plant and a $750,000 power and steam plant. Hedrick & Stanley, 1200 T&P Bldg, Fort Worth, Tex., architect and consulting engineer.

Levenworth, Wash. — Public Utility District No. 1 of Chelan County, Wenatchee, Wash., a Washington State public utility district, has requested permission from the FPC for authority to build a $38,600,000 power dam on a tributary of the Columbia River. Company plans to build a 200-ft-high rock filled dam on the Wenatchee River, about five miles upstream from this city. Project when completed will generate 180,000 kw of electricity for sale to existing customers.

Seattle, Wash. — University of Washington, Seattle, has awarded contract for erection of new steam generating unit and auxiliary equipment for $1,900,000 central boiler plant. Bouillon & Griffith, consulting engineers.



PACKAGED STEAM by FW

helps load more than 7,000,000 gallons of oil in less than 3 months

When U. S. refiners recently were required to meet a sudden, extended demand from Europe for oil, one of the key points of supply was the Magpetco Terminal of Magnolia Petroleum Company. With storage capacity for some 4½ million bbl of petroleum products, this southeastern Texas tank farm was a "natural" for emergency use as a crude oil outlet point – 7,000,000 gallons of crude oil were loaded in less than 3 months.

The two Foster Wheeler Packaged Steam Generators shown above not only met all the normal load requirements but demonstrated ample reserve capacity for emergencies. They provided a reliable source of steam which was essential to operate the many large reciprocating pumps and to heat heavier oil in the storage tanks to facilitate pumping.

Chosen by Magnolia engineers to replace outmoded steam equipment at the terminal, the units are installed outdoors. Casings are of all steel welded construction with weatherproof insulation over the drum ends. Each unit delivers 30,000 lb of steam per hour at 150 psi. Dimensions are: 10′ x 28½′ x 12′ high.

FW Packaged Steam Generators are available in capacities from 10,000 to 62,500 lb/hr and pressures to 1300 psi. For complete information, send for Bulletin No. PG-55-3. *Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.*

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For more data circle 529 on Post Card

EQUIPMENT NEWS

1—ELECTRIC DRILL gives impact plus regular action

The Uni-Drill is a selective action ¼-in. electric drill designed to combine regular action and pneumatic type impact action for carbide masonry drilling. Rated at 3 amp industrial for continuous service, the drill takes up to 1-in. carbide masonry drill bits. Drill speed is 2500

rpm; 1700 rpm under load. Weighing less than 6 lb, the Uni-Drill is handy for scaffold and overhead work, and is said to require a 15-lb pressure to drill at a normal rate. Manufacturer reports that on tests this unit has drilled a ½-in. hole in 3-in. concrete in less than 30 sec.

A selector control on the drill turns to release the internal impact cam, allowing it to float for conventional drill action in wood, steel and similar materials. The drill obtains impact action by means of two cams and a 30-lb pre-loaded spring. Power developed is measured at 90,000 impact lb/min, according to manufacturer. The drill has a standard Jacobs ½-in. chuck for carbon and high speed bits; adaptors are furnished for carbide masonry drills. Powers Tools Corp.

2—TRANSMITTING INSTRUMENT measures viscous fluid levels

The Type 13 FA d/p Cell Transmitter is a differential pressure liquid level device which mounts directly on a tank nozzle to provide a simple method for measuring viscous or slurry-type liquids in open or closed vessels. It operates on the force balance principle and is said to maintain calibrated accuracy over a wide range of ambient conditions. The level measuring element — a silicone-filled diaphragm capsule — is assembled in a 3-in. flange for flush mounting on the side of a vessel. Head of liquid in the vessel applies force to the high pressure side of the capsule which is opposed by force on the low pressure side. The latter may be open to atmosphere for measurement of open tank level. Or it may be connected by piping to top of a closed tank to balance out static pressure. Adjustable range suppression and elevation springs can be attached. The pneumatic output of the transmitter — a 3–15 psi signal proportional to tank level — will operate a remote indicator, recorder, or controller, it is noted; company says no auxiliary signal is needed. The Foxboro Co.

Reader Service Cards on pages 131–132 make it easy to get further information on any of these products. Just circle the item numbers of the products you want to know more about.

3—LIQUID ADDITIVE reduces oil ash corrosion

Barsad is announced as a liquid, oil-soluble chemical which may be added to Bunker C and other heavy fuels to make them less corrosive when burned in diesel engines, and gas turbines and under boilers. This corrosion occurs during the combustion process, it is pointed out, and is caused by the sulfur, vanadium, sodium and salt water present. With Barsad, more intimate contact between the additive and fuel is claimed possible. Its effectiveness in minimizing effects of oil-ash corrosion is explained in a technical article available to power engineers. R. S. Norris Associates.

4—COLORIMETRIC ANALYZERS for hardness, silica content

Quantichem automatic analyzers are designed to continuously analyze water for total hardness or silica concentration. Each analysis is on a fixed time cycle with results recorded on a separate unit that may include alarms or control devices. Analyses are based on effects of silica or hardness-causing calcium and magnesium ions on specific reagents which change the amount of light a given volume of sample solution will

absorb or transmit. The difference in amount of transmitted light through a zero cell and a test cell is measured photoelectrically, and because difference is proportional to concentration of silica or hardness, the instruments are calibrated to read in units of concentration.

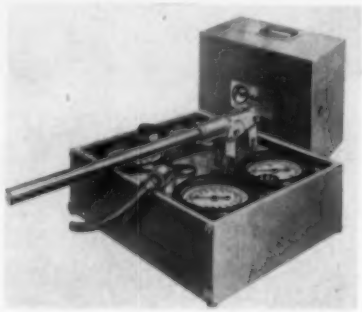
Silica analyzer has a range of 0 to 0.05 ppm. Standard ranges for total hardness analyzers are 0–3 and 0–5 ppm with a sensitivity of 0.03 and 0.05 ppm, respectively, calibrated as calcium carbonate. In effect, the analyzers are miniature laboratories which automatically perform all steps of an analysis from flushing of sample cells and calibration of photoelectric measuring circuit to metering of reagents and recording of results. When one analysis is completed, analyzer starts testing a new sample. Each silica analysis takes 12 min while each hardness analysis takes 6 min. Water to be tested must be available at pressures above 10 psi and temperatures below 100 F. Milton Roy Co.

5—LUG KIT permits adding sub-feeds to panelboards

This sub-feed lug kit makes it possible to add sub-feeds to standard NQO circuit breaker lighting panelboards, company announces. It is available for both 100-amp and 200-amp main lug only panelboards and includes necessary parts to allow simple conversion of the standard merchandised panelboard. Together with the three-pole breaker, the sub-feed lug kit allows the majority of panelboard problems to be solved from local distributor stocks. Square D Co.

6—PORTABLE TESTER for valves, other equipment

This utility version of manufacturer's Porta-Tester weighs only 55 lb and is contained within a carrying case. It is

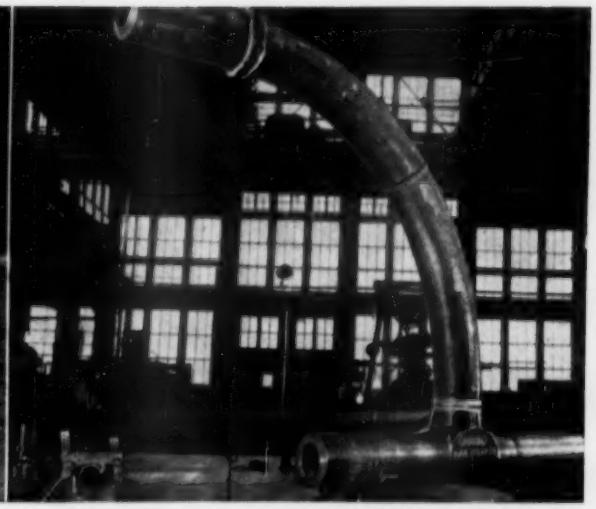


suggested for at-the-site hydrostatic testing of valves, pressure vessels, piping, steam generators, pump cases, other process equipment, to pressures up to 3000 psi. The unit is only 18-by-14-by-8 in. and is complete with four gages and 8 ft of hydraulic, flexible tubing that packages on the rear of the cover. The pump handle folds flat for storage in the case. The unit can be used with water or other hydraulic fluids. Farris Engineering Corp.

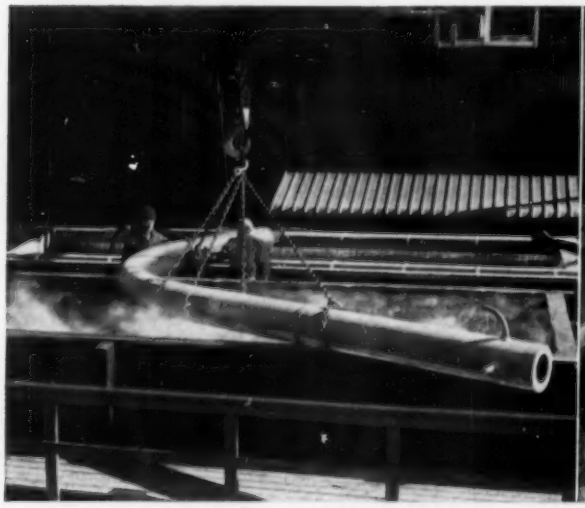
7—VAPOR CONDENSERS have increased capacities

Aero Vapor Condensers which replace barometric type condensers when needed to conserve water and to provide higher vacuum for evaporators are now available in increased capacity models. The steam or vapor is condensed in tubes over which water is sprayed, removing heat by evaporation in a stream of air, conducting the heat outdoors. Air, or non-condensible gas, mixed with vapor or steam to be condensed, is removed by steam ejector nozzle or vacuum pump, and is separated from condensate by specially designed screening baffle-tube in condensate drain. Purpose of

Crane's skilled shopmen bend 17¾" O.D. pipe with 3½" wall. Pipe bend is for steam service—1970 lbs. at 1050 deg. F.



Experienced Crane welders have welded the bend (see photo 1) to header. Pipe is 2¼% chrome, 1% moly, alloy steel. Unit shown weighed 15,000 lbs.



Pipe bend fabricated by Crane is being pickled as part of cleaning procedure. Pipe is chrome-moly alloy—2.539" wall thickness; 13.578" O.D. Unit weighs 9050 lbs.

Pipe shown at left also was shot-blasted. Combining pickling and shot-blasting assures maximum interior cleanliness.

Let CRANE fabricate your heavy-wall pipe

Do your high pressure-high temperature piping specifications call for bending and fabricating pipe of greater wall thicknesses than the maximums shown in Schedule 160 thicknesses?

Crane shops for years have been processing heavy-wall pipe ranging in thicknesses up to 3.750"; in O.D. pipe sizes from 11.690" to 21.000"!

Crane facilities include bending, welding, upsetting, machining, full furnace stress-relieving or heat treating, radiographic inspection, and thorough interior cleaning.

All Crane facilities are housed under *one* roof for fastest service—and controlled and operated under *one* responsibility. Thus, you are assured of traditional Crane quality in materials, engineering supervision, and skilled shopmanship—that effect important economies in erection, operation, and maintenance for years to come.

For prompt consultation write to address below.

CRANE FABRICATED PIPING

VALVES • FITTINGS • PIPE • KITCHENS • PLUMBING • HEATING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

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apparatus is to achieve lower condensing temperature and more effective subcooling, providing better separation of non-condensibles to increase yield and obtain purer, more highly-refined product (in case of foods, better flavor). Condensing temperatures are within 20 F of atmospheric wet-bulb temperature. Niagara Blower Co.

8—PVC TUBING is light in weight, flexible, transparent

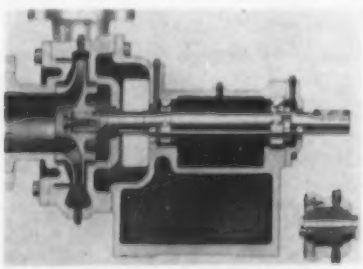
Bardex is described as a metal reinforced PVC tubing of exceptional flexibility. Manufacturer reports that it has been flexed to an angle of 90 deg over 1½ million times without cracking or breaking, and that it will bend around a $^{5}/_{16}$-in. diam spindle without its internal bore being reduced. It is claimed weatherproof and resistant to acid, gasoline, oils, high octane fuels and sea water. According to manufacturer it will not kink, is self-extinguishing and has a working temperature from −5 to 170 F, with working pressures from 100 to 200 lb. Electrical conduit is among applications suggested for it and its transparency makes it suitable for sight feed. Six inner diameter sizes range from ¼ to 1 in. Tensile strength of Bardex is given as 2200 psi; cold break temperature, −50 F. A leaflet and sample are offered. Newage Industries, Inc.

9—SHAFT MOUNTED DRIVES available in higher ratio

Now in this company's line of all-steel, double reduction, shaft mounted drives is a new higher ratio of 24:1 (or 20:1 in two smaller sizes). Outside dimensions and torque ratings remain the same. Practical advantages attributed to the higher ratio units include: use of smaller sheaves to obtain a given output speed; and a saving in motor cost when, because of the lower output speed, a 1750 rpm motor can be used instead of a slower speed motor. Units are available for horizontal and vertical application, in ½ to 30 hp ranges, with output speeds as low as 5 rpm. Selection tables are offered. The Falk Corp.

10—CENTRIFUGAL PUMPS for general water service

Model BH Pumps are high-speed, high-head centrifugal pumps available in four sizes: a 1-in. model with capacities to 150 gpm; a 1½-in. model, to 220



gpm; a 2-in. model, to 440 gpm; and a 3-in. model, to 520 gpm. All are reported to perform at high efficiency over wide service conditions and offer long life. Features announced include stainless steel shafts, oil-lubricated heavy-duty ball bearings, mechanical seals, and hydraulically balanced bronze impellers. Gardner-Denver Co.

11—FILTER-SEPARATOR for fuels and oils

This filter-separator of the replaceable-cartridge type is designed to remove condensed water, water-borne contaminants and solids from fuels, oils, solvents and other oleaginous liquids at flow rates of 5 to 40 gpm. It is also reported suitable for a variety of aqueous solution treatments. Known as the SV-11 or SV-11A, the unit takes vertically a square foot of floor space, and has 1¼-in. horizontal inlet and outlet connections at 3 and 52 in. from floor, respectively. Maximum working pressure is 150 psi, with initial pressure drop about 1 psi. Automatic controls handle continuous discharge of separated water and serve to keep slugs from working up into the clean fuel outlet.

Rated at 15 gpm, the unit handles light fuels at 30 to 40 gpm, kerosenes at 20 to 25 gpm, and heavy diesel fuels at 10 gpm. Features announced include complete removal of undissolved water from hydrocarbon liquids, operability under vibration or tilt up to 45 deg, and easy replaceability of low cost cartridge. It is pointed out that this unit adapts military fuel filtering processes to smaller uses. Richmond Engineering Co.

12—DUST COLLECTOR, wet method, offers economy, efficiency

This vertical rotor dust and fume eliminator is introduced as a relatively low-priced, yet efficient wet method collector. In it, contaminated air enters at high velocities and a cyclonic action is set up in the outer chamber, causing larger particles to drop into the surface of the integral tank. The air stream then passes through a vertical water curtain to eliminate heavier particles, then through a high velocity horizontal water curtain to remove finer particles and remaining contaminants. A series of baffles removes excess moisture before purified air is either vented to atmosphere or returned to working area. The unit is easily maintained, says manufacturer; it can be constructed of corrosion resistant alloys or lined where necessary. It features low overall height to fit into trusses. Details are in Bulletin VRU-4-57. Schmieg Industries, Inc.

13—WATER HOSE offered in two new types

Industrial Water Hose is primarily designed to handle varied industrial water discharge requirements with maximum economy and is available in a large selection of sizes. Announced by same manufacturer is Performer Air-Water Hose. This product is reported to meet the need for water discharge applications where moderate pressures are required, and for economical air service where oil resistance is not a factor. The Boston Woven Hose & Rubber Co.

14—VOLTMETER is battery-operated electronic instrument

This battery-operated, a-c electronic voltmeter, featuring a space-saving, all-transistor design and printed wiring, is claimed to offer unusual sensitivity and accuracy. Called the Type 10A, it is a compact instrument which can be carried in one hand. No warm-up period is required, manufacturer points out, and the absence of drift assures stable readings as soon as the instrument is turned on. This voltmeter is designed to measure voltages from 1 mv full scale to 300 v full-scale, within the frequency range of 20 cycles to 500 kilocycles. Its large meter swing enables voltage differences as small as 0.5 per cent to be detected, company states. Bulletin 7001 gives data. Alectra Div., Consolidated Electrodynamics Corp.

15—CHEMICAL SPRAY protects the outdoor storage piles

Permaspray is reported to blanket and protect outdoor storage piles of bulk materials against weather conditions for periods up to a year or more. The product is a colloidal suspension in water of a chemical which forms a tough, flexible, water-resistant film when exposed to air and hardened. It is suggested for coating stock piles of coal, ores, coke breeze, flyash, sulfur, other materials in dead storage. Manufacturer says the deposited film resists action of wind, rain, frost and heat, and stops dust nuisance and windage loss. By stretching and deforming in heat and cold the film remains unbroken, it is explained; thus it drains away water which would ordinarily seep into the stored materials and reduces normal winter damage. It is also claimed to eliminate guttering or channeling, often caused by heavy rains.

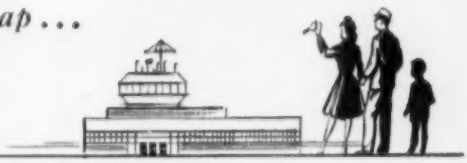
Permaspray is described as non-toxic, non-corrosive and having no adverse effect on burning qualities of coal. When the surface film is broken, as when coal is withdrawn, the area can be redressed and coating applied. The product has the approximate consistency of water, and can be handled in any type of spray equipment with the exception of very coarse or very fine nozzles. It is applied at the rate of one gallon to 100 sq. ft. The film sets in 24 hr under normal conditions. The Johnson-March Corp.

16—SILICON RECTIFIERS for electrostatic precipitators

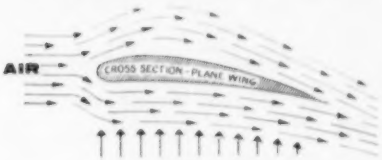
Electrical and physical advantages of silicon rectifiers are available to users of electrostatic precipitators in this oil-immersed silicon rectifier set. These units are said to have numerous economies in operation and maintenance and to extend precipitator rectifier life at

HOW THIS MODERN STEAM TRAP UTILIZES PRINCIPLE OF AIRPLANE LIFT!

New application of an old principle produces totally different type of steam trap . . . of great simplicity and effectiveness



THIS GIVES AN AIRPLANE LIFT



Greater speed of air over curved upper wing surface creates lower pressure over this area (Bernoulli's Law) . . . resulting in **lifting** force.

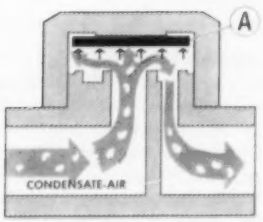
THIS SAME PRINCIPLE USED TO CLOSE SARCO TD STEAM TRAP VALVE

Valve is a simple hardened stainless steel disc.

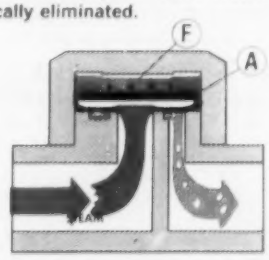
High velocity steam jet across bottom of valve disc creates low pressure area — resulting in **downward** force.

ONLY SARCO TD USES THIS UNIQUE OPERATING PRINCIPLE

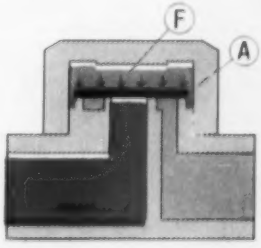
Result: Extreme simplicity—no valve mechanism—maintenance practically eliminated.



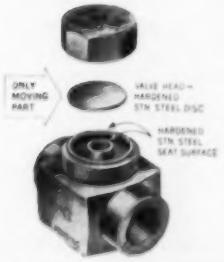
1. Inlet pressure raises disc "A" from seat . . . immediate discharge of air and condensate at steam temperature.



2. Steam follows condensate and the high velocity jet across bottom of disc "A" creates low pressure area (Bernoulli effect) . . . jet is deflected into chamber "F" where it builds up pressure by re-compression and this pressure acts on top of disc "A" . . .



3. Pressure in chamber "F", acting on full top area of disc "A", exceeds force of incoming steam and low pressure area under disc . . . and immediately forces it down, closing inlet. As condensation decreases pressure in chamber "F", disc rises and steps 1 or 2 repeat.



Small size . . . large capacity

Only 3 parts . . . all stainless steel. Sizes ⅛ to 1"—each body is as small as a tee fitting! Capacity is determined not by a bulky body but by the effective orifice, valve action, pressure drop and condensate temperature.

A few of many advantages

* *Practically no maintenance*—no valve mechanism, no narrow channels. Trouble-free, simple design.

* *Cuts trap inventory*—one large capacity seat for all pressures . . . for heavy, light, or no condensate load.

* *Self-adjusting for pressures 10 to 600 psi*—not a single change or adjustment required.

* *Operates perfectly when pressure fluctuates*—throughout full pressure range.

SEE FOR YOURSELF

We will gladly send you a Sarco TD Steam Trap and strainer for 60-day trial. No cost or obligation. Advise size —⅛, ½, ¾ or 1"—and application. Sarco Company, Inc., 635 Madison Avenue, New York 22, N. Y.

2204-C

SARCO Thermo-Dynamic STEAM TRAP

THE MODERN TRAP THAT IS MAKING STEAM TRAPPING HISTORY!

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least ten years. Basic components of precipitator electrical equipment are the control unit, power transformer, and the rectifier for changing the high voltage a-c transformer output to the d-c used in the precipitator. The silicon rectifier consists of a number of minute silicon cells connected in series on a frame immersed in oil with the transformer. Units are available with rated output 70 kvp and 500 ma. Those presently available are designed for application on new electrostatic precipitator installations. Modified designs to replace mechanical rectifiers are being prepared for combination with the transformers presently installed with these units. Research-Cottrell, Inc.

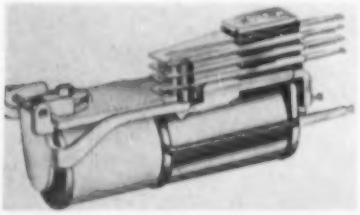
17—FLEXIBLE SHAFT has equal torque in both directions

Features announced for this flexible link shaft include equal torque in both directions, unlimited length and equal flexibility in all sizes from $\frac{3}{16}$- to 3-in. diam. It is declared suitable for remote controls and power drives. The links

consist of trunnion blocks and two half links fastened together with screws or rivets. A variety of cover materials are available including Neoprene hose, nonmetallic hose or semi-rigid tube. End fittings are available as required. Minimum link length is three times the diameter and various link lengths can be combined in one shaft using long links for straight runs. Long life is said to be a characteristic of this shafting. Complete information on the flexible shaft is presented in a recent booklet, "A New Link Arm for Industry." Clark Flexible Link Shaft Co.

18—TELEPHONE RELAY is versatile, economical control

This relay has contact combinations up to ten pole double throw. Contacts are rated for 3 amp, 150 w, a-c, noninductive load. The relay can be sup-



plied with copper head for delayed attract up to 0.1 sec, depending on spring assembly and coil power; copper heel for delayed release up to 0.4 sec with small spring assembly and power coil. It is reported to give exceptional response and to be capable of operating at high speeds for long continuous service. Manufacturer says this relay is equal to and interchangeable with other telephone relays that are now being used. Guardian Electric Mfg. Co.

19—COUPLING METHOD for joining the lightweight tubing

Vic-Easy is announced as an economical method of quick coupling thin wall steel and aluminum pipe and tubing. The method, which utilizes quick couplings assembled on grooved pipe ends, is reported to provide leak-tight connections. (Several mills can supply a wide range of wall thicknesses and weights of tubing and pipe with Vic-Easy rolled grooves.) There is no loss of metal in the rolling, it is claimed, and the pipe or tubing is as sound structurally as when manufactured. The Vic-Easy Method is for thin wall pipe and tubing in sizes from $1\frac{1}{4}$ to 12 in., and may be used for working pressures to 1000 psi, depending on wall thickness of tubing and type of coupling used.

Economies reported include greater speed and fewer man hours for piping installations — one man can make the joint. Also, savings are realized with the lower initial cost and lower transportation costs of the lightweight tubing. And the method lets you select pipe rated for the job requirements. Coupling is declared quick and easy. When tubing ends are brought into position, a gasket, furnished with the coupling, is slipped onto one of the pipe ends. It is then positioned over the joint of the pipes and the coupling put in place over the gasket and fastened. The joint is flexible, allowing some deflection in any direction. There are three types of couplings. A snap-joint type, a hinged assembly fastened by leverage and tension, requires no tools for installation. Requiring only a wrench for installation are a lightweight, economical coupling for low pressure, low external stress application, and a heavy-duty coupling used where high external stress or internal pressures are expected. Victaulic Co. of America.

20—ROOF VENTILATOR has emergency damper opener

As a fire safety factor for modern one story industrial plants, utilizing sprinkler systems, a safety vent emergency damper opener has been made an integral part of this company's high-velocity power roof ventilator. The unit, which is independent of fan operations, serves to allow smoke and fumes, which normally are trapped, to escape — permitting faster access to the area by fire fighters. Operating on the principle of heat actuation, this unit is automatic in that it uses no electrical devices, wiring, thermostats, or counterweights. It is controlled by a spring, outside the air stream of the fan, which is held in tension by a fusible link. Excessive heat breaks the link, which releases the spring raising the dampers. This spring is shielded from flames by the damper blades, it is pointed out, and prevents annealing and loss of tension. Chicago Blower Corp.

21—WIRE STRIPPER works fast, has longer shelf life

Super X-Var, a chemical wire stripper formulated for fast stripping action on Formex, Formvar and enamel insulation, is now offered in glass containers. Use of glass containers is reported to increase product stability, which, combined with a more homogenous mix, results in faster stripping action and longer shelf life. According to manufacturer, Super X-Var removes all traces of insulation from wire in as fast as 5 sec, depending on thickness and brand, leaving the wire ready for soldering. Fidelity Chemical Products Corp.

Described on these pages are new and improved products. Use Reader Service Cards on pages 131–132 to ask for more information on them. Just circle the item numbers of all the products in which you are interested.

22—TRANSFORMERS mount at point-of-load

This line of three-phase power circuit transformers can be mounted at the point-of-load. Their low noise level of less than 45 decibels suggests their use where quiet operation is desired. It is pointed out that by mounting them at the point-of-load, wiring and labor are reduced. They can be mounted to ceiling, wall, floor — on bottom, top, and/or sides. The use of Class B insulation reduces their size and weight, company says, and by eliminating the cover and exposing the core surface, these transformers are safer and easier to clean and run cooler. Jefferson Electric Co.

23—STARTERS offer protection for the synchronous motors

These synchronous starters (2200–4800 v) are introduced as a simple, safe method for starting and bringing synchronous motors into synchronism. A push of the start button gives protection during starting and running, manufacturer states, plus automatic synchronization It is explained that syn-

STEPHENS-ADAMSON

A section of a 300 TPH belt conveyor system at a midwest power station. Design permits future expansion which will double present capacity.

for mechanized economy in coal conveyor systems

Moving coal from a receiving point to combustion at lowest possible cost is a vital problem in central power stations, private industrial plants, service institutions—wherever coal is used for steam generation.

The trick in the moving is knowing how to apply modern, scientific conveying equipment to any given set of conditions. How will coal arrive at the plant? What are generation requirements? What specific types of handling equipment are needed? What are storage needs inside and out? STEPHENS-ADAMSON engineers probe the problem all the way. These same men know there is no such thing as a "typical" power plant conveyor system. It must be designed purely to meet existing conditions and with plenty of foresight for future demand.

To provide the tools the engineer needs, STEPHENS-ADAMSON manufactures a complete line of coal handling equipment. It is a quality line designed from long experience, built to last for years of trouble free service.

For the ultimate economy in coal handling systems, see the STEPHENS-ADAMSON representative in your area. Learn why it pays to convey the S-A way.

An S-A system serves the needs of the Potomac Electric Power Co., Washington, D. C. Existing facilities have been designed with provision for ultimate 493,000 KW output. This is a typical example of how Stephens-Adamson engineering provides for future power expansion needs.

Brantly Steam Station, Danville, Va., is served by an S-A conveyor system. Compact REDLER conveyor-elevators are used to good advantage to convey coal to silo and stockpile storage. A pan feeder serves to move coal from track hopper and also reclaims from storage pile.

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S-A manufactures a wide range of material handling products in three complete plants in U. S. and Canada.

- Belt Conveyors
- Belt, Pan & Plate Feeders
- Ship Loading Boom Conveyors
- Stacking Conveyors
- Storage & Reclaiming Systems
- "Natural Frequency" Vibrating Conveyors
- REDLER Conveyor-Elevators
- ZIPPER Conveyor-Elevators
- Conveyor Belt Cleaners
- Headshaft Holdbacks
- Grizzlies & Screens
- Centrifugal Pilers
- Bin Gates & Tunnel Gates
- Car Pullers & Spotters
- Bucket Elevators
- Skip Hoists
- SEALMASTER Ball Bearing Units

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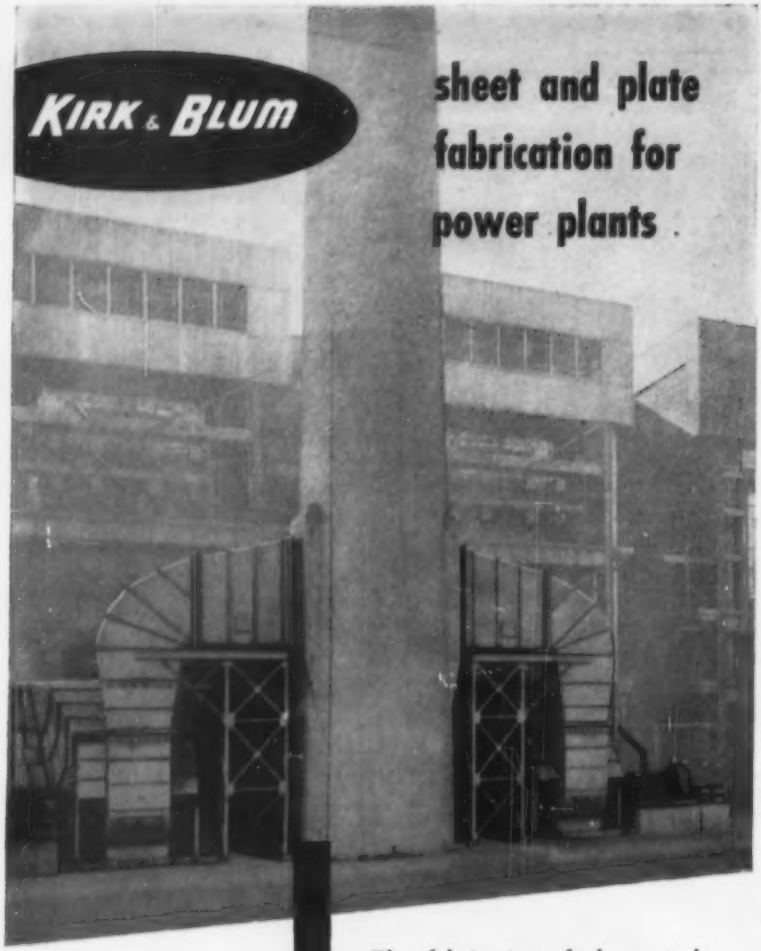

- breechings
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- insulation jacketing
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Send prints for prompt quotation or write for your copy of the latest Kirk & Blum Sheet and Plate Fabrication Booklet.

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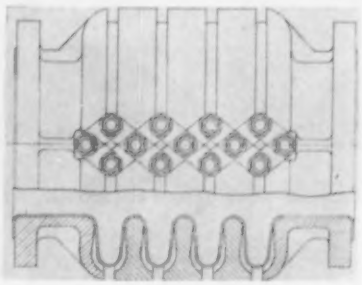
chronization occurs at the most favorable time, and should the motor pull out of step because of voltage dip or overload, the field is automatically removed. Re-synchronization occurs when the motor re-accelerates the load. Current-limiting power fuses, working in conjunction with high-interrupting-capacity ZHA air-break contactor, serve to provide short circuit protection. Further information may be found in Bulletin 8210. Electric Controller & Mfg. Co., Div., The Square D Co.

24—EXPANSION JOINTS offer major design improvements

Duo Equalizing Joints are announced as expansion joints in which movement of power and process piping systems is shared equally by all corrugations. They are suggested for all-weather outdoor piping systems and indoor systems operating on frequent on-and-off cycles to protect piping and equipment against damage due to temperature changes. Equal distribution of pipe expansion

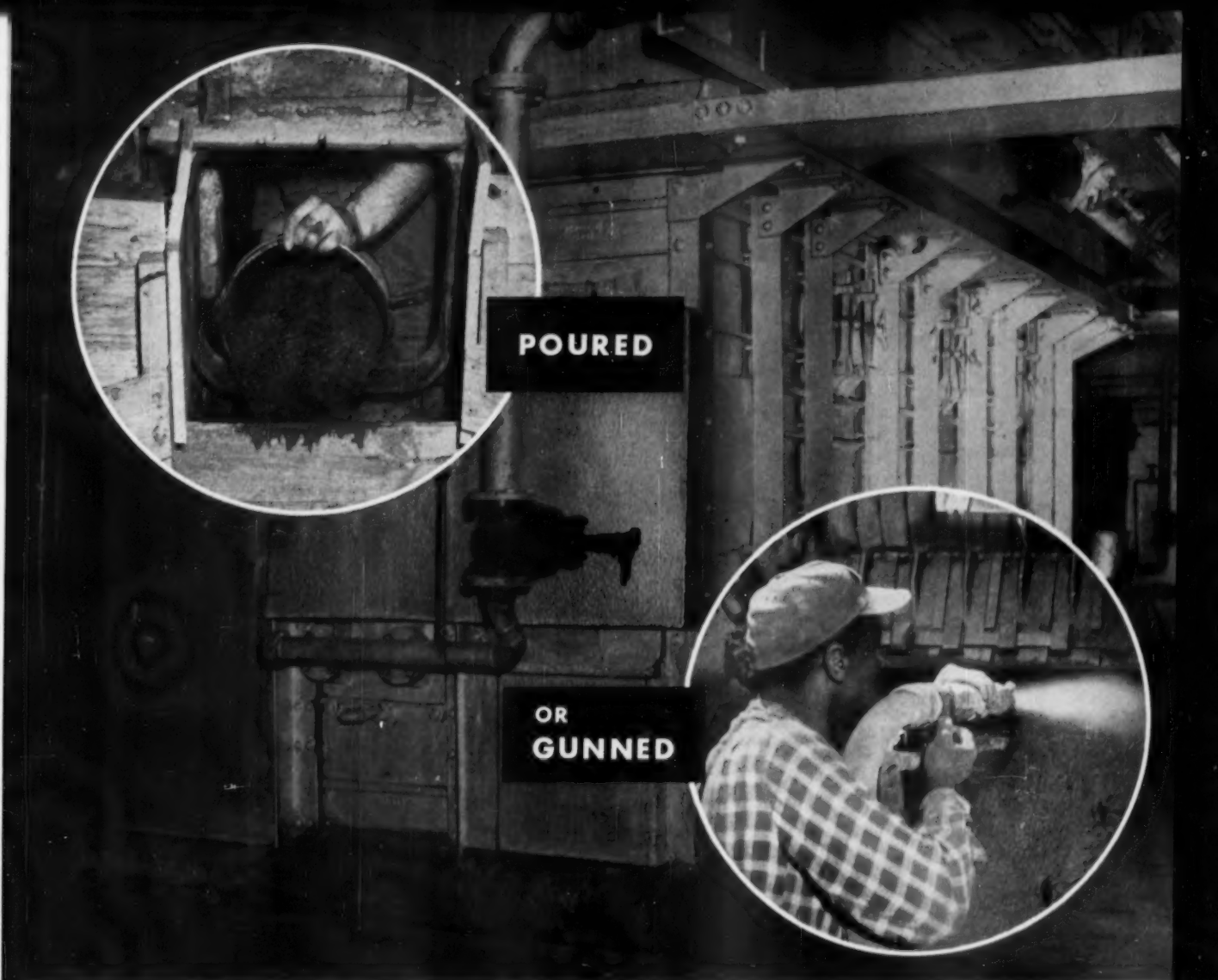


and contraction to all corrugations is accomplished by pantographs, as illustrated. Pantograph neutrals are anchored to the end fittings and intermediate equalizing rings. End fitting movement is immediately transferred by the pantograph to all equalizing rings, it is explained, moving all rings the same distance at the same time to prevent undue stress to any one corrugation.

Advantages claimed for the new expansion include: 40 per cent longer life than self equalizing expansion joints at same pressure and movement; 30 per cent less overall length; 30 per cent less weight; and greater stability at high pressures. The units are stainless steel, available in sizes from 3- to 72-in. diam and for traverses to 7½ in. in a single, 15 in. in a double unit; they are designed for 150 and 300 psi working pressures. Company also makes this style unit in copper for use with copper or brass piping. Zallea Brothers.

25—PROTECTED TRANSFORMERS, in single and two bushing types

Full current protection for ratings from 10 to 100 kva is said to be provided by Type FCP Distribution Transformers for utility and industrial services. Full current protection plus surge protection is provided by the Type FSP. Both types incorporate internal circuit breakers, internally mounted primary fuses, warning signal lamp and emergency overload device. Circuit breakers, mounted directly above core and coils, are submerged in oil. They are tripped by bimetal elements sensitive to transformer winding temperature. Breakers are series-connected in the low voltage winding. As maximum safe transformer load is approached, temperature rise



B&W Kaocrete Refractory Castables withstand punishing ashpit service

Continuous or intermittent sprays, high velocity water jets for ash removal, rakes and shovels — all these are responsible for the heavy abrasive and erosive attack on ashpit linings. But you can cut the frequency of maintenance and expensive relining jobs by using heavy-duty refractory castables which can be poured or gunned in place.

Specially designed for ashpit service, B&W Kaocrete D has the strength and hardness needed to stand up under these severe conditions. It has unusually high resistance to abrasion, erosion and spalling. Widely used in all types of boiler ashpit hoppers and slag tanks, Kaocrete D has proved its economy and durability. Where abrasive and erosive conditions are less severe, B&W Kaocrete A will give satisfactory service.

Your local B&W Refractories Engineer will be glad to give you complete details on the performance of these B&W Refractory Castables.

Send for Bulletin R-40 which gives data on B&W Kaocrete Refractory Castables for lining ashpits.

B&W REFRACTORIES PRODUCTS: B&W Allmul Firebrick • B&W 80 Firebrick • B&W Junior Firebrick • B&W Insulating Firebrick • B&W Refractory Castables, Plastics and Mortars • B&W Silicon Carbide

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R540

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Improved Operation

of literally hundreds of mechanical products has been effected

with Acco Tru-Lay *flexible* PUSH-PULL Controls

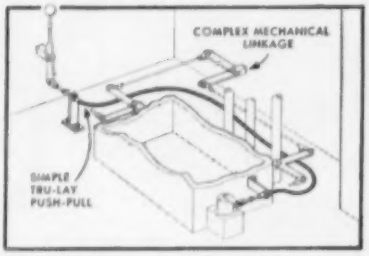
Tru-Lay Push-Pull Controls provide POSITIVE REMOTE-ACTION over long or short distances . . . with fixed or movable anchorages . . . for light loads or loads up to 1,000 lbs., and these units are frequently and successfully used in conjunction with Electric, Hydraulic and Air Controls.

Flexibility makes it possible to snake around obstructions . . . simplifies installation . . . reduces the number of working parts.

Advantages of Tru-Lay Push-Pull flexibility and simplicity are pictured below

Simplicity vs Complexity

Compare the TRU-LAY PUSH-PULL cable in illustration with the mechanical linkage. PUSH-PULLS are simple, have but one moving part, are noiseless and give lifetime service accuracy. Linkages are complex, made of many parts; they wear at many points. Their use brings increased backlash, lost accuracy and vibration rattles.



Positive Remote-Action and Flexibility, together with Precision and Long Life, explain why TRU-LAY PUSH-PULLS serve designers and users equally well in improving machine operations, whether the application is on such severe service jobs as Bulldozers, Power Shovels and Steel Mill Machinery, or on such light duty work as Photographic Equipment, X-Ray or Business Machines.

Immunity to Vibration makes these TRU-LAY PUSH-PULLS ideal as Remote Controls on shakers and other vibratory products.

Complete Protection Against Dirt and Moisture is a big factor in the use of this unit on machinery in Coal Mines, Cement and Steel Mills, Oil Fields and in many other industries.

Corrosion-Resistance of the unit, plated or with Stainless Steel construction as required by the use, has led to many applications in the Marine Field . . . salt water or fresh. Supplied with a rubber cover the unit operates effectively even when the conduit is COMPLETELY IMMERSED in water.

Lubrication of the inner member and conduit are for life.

Temperatures as low as −70°F will not hinder the proper operation of this unit, and it is thoroughly effective even in the extreme high temperatures encountered on Jet Engine, Furnace Door and Glass Furnace Damper control applications.

Our ***DATA FILE*** *will answer your further questions*
Write for a copy without obligation

Push-Pull DATA FILE

ACCO

AUTOMOTIVE and AIRCRAFT DIVISION
AMERICAN CHAIN & CABLE

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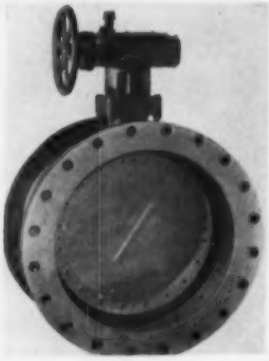
For more data circle 535 on Post Card

deflects the bimetal and connects a red warning lamp. If load and temperature continue to rise, further deflection trips the breaker and disconnects the secondary load.

Service can be restored while the transformer is hot by movement of an emergency overload lever below the warning lamp. It is noted that excessive overload condition will automatically recycle the protective devices when the lever is held in "on" position. In addition to the above features, the Type FSP Transformers incorporate surge protection with a valve type lightning arrester. Pacific Switchgear Div., Federal Pacific Electric Co.

26—BUTTERFLY VALVE offers operating advantages

Darling-Pelton Butterfly Valves feature a unique seating principle and unusual operating characteristics, it is announced. Advantages claimed for these



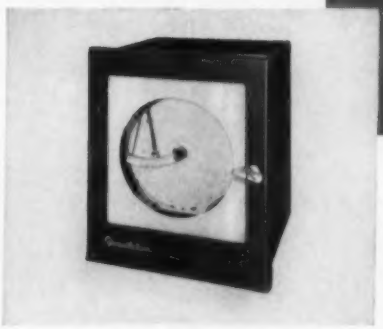
rubber-seated valves include: lower operating torque, adjustability of seat for tight shutoff; seat replacement without removal of shaft or operator; increased operating cycles before part replacement or maintenance is necessary. Designed to eliminate shaft sealing problems, the rubber seat is a continuous ring integral with the disc. The valves come in sizes from 4 to 72 in. for pressures in the 50 to 250 psi range, and are intended for all types of manual and air or hydraulic cylinder operation. The butterfly valves are made under licensing agreement with the designer, Pelton Div., Baldwin-Lima-Hamilton Corp. Darling Valve & Mfg. Co.

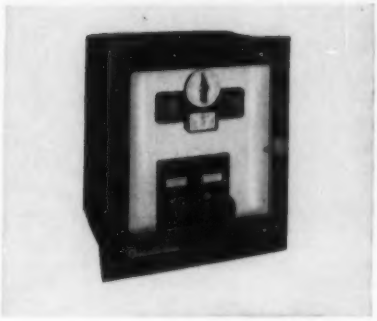
27—DESUPERHEATER features variable orifice design

According to manufacturer of this desuperheater, tests over a load range of 50 to 1 show that reduced steam temperature can be held constant only 20 ft downstream from the outlet. No long run of piping is needed to mix cooling water intimately with steam, it is pointed out; nor is atomizing steam required. The desuperheater consists of a section of steel pipe enclosing a self-regulating orifice extending around the full 360 deg and a weighted ball held in concentric position by Inconel springs. Cooling water, controlled by a diaphragm-operated valve, enters orifice chamber at uniform flow rate around periphery.

In operation, force of the steam flow raises the ball an amount determined by its weight and the amount of steam flow. Each rate of steam flow gives the ball a different position, with a practically-constant pressure drop — normally

Quantichem automatic analyzers for total water hardness and dissolved silica concentrations include the electronic colorimetric unit and the recorder. These analyzers are especially important in the operation of water treating facilities for high-pressure steam power plants.





Automatically analyze water for silica and total hardness

...with the field-proven Quantichem instrument

All the steps of an analysis . . . from the flushing of sample cells and calibration of photoelectric measuring circuit to the metering of reagents and the recording of results . . . are performed by the new Milton Roy Quantichem instrument. This automatic analyzer is, in fact, a miniature lab for analyzing water for total hardness or silica content. Units are now in actual customer use after more than three years of research and field testing.

The silica analyzer has a range of 0 to 0.05 ppm . . . standard ranges for the total hardness analyzers are 0-3 and 0-5 ppm. Concentrations of other constituents in water, such as iron and phosphates, can also be analyzed by this unit. For these and other applications of this analyzer, consult our instrument engineers. Bulletin 1156 contains detailed information on the Quantichem instrument . . . write for your copy.

Suncoast Instrument Division, MILTON ROY COMPANY,
1300 E. Mermaid Lane, Philadelphia 18, Pa.

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CHEMICAL INSTRUMENTATION SYSTEMS

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BIDDLE *Instrument News*

Meg® Type
of Megger
INSULATION TESTER

With NEW A-R-K Switch Gives You ALL THESE FEATURES IN ONE INSTRUMENT

- Megohm Scale ÷ 1 and ÷ 10 (Formerly the A switch)
- Ohm Scale (Formerly the R switch)
- Capacitance Discharge (Formerly the K switch)
- Earth, Line and Guard terminals—no need to change terminal connections when switching to ohm scale

This multi-purpose switch affords you all these features in one instrument. Available with voltages of 500 or 1000 volts d-c and with ranges from 0 to 20 up to 0 to 2000 megohms—0 to 10,000 ohms.

For prices and specifications write for **BULLETIN 21-45-PE**

Biddle Motor and Phase Rotation Tester (*Dual Purpose*)

With it you can . . .

- **Determine the direction of rotation of electric motors before they are connected to the line.**
- **Determine the phase rotation or sequence of energized power circuits.**

Here is a positive means for determining which motor leads must be connected to certain conductors of a supply system to insure that the motor will rotate in a prescribed direction when energized.

This device will permit the electrical contractor or industrial maintenance electrician to permanently connect and tape the terminals of the motor being installed, without having to first energize the motor by a temporary "hook-up" from a power source, if available, to determine its rotation.

Housed in a sturdy oak case 12¼" x 8¼" x 4¼" this compact unit weighs approximately 10 pounds and is supplied complete with 3 line and 3 motor leads which store in the compartments either side of the instrument panel.

For complete details write for **BULLETIN 80-PE**

8-7128

JAMES G. BIDDLE CO.

- ELECTRICAL TESTING INSTRUMENTS
- SPEED MEASURING INSTRUMENTS
- LABORATORY & SCIENTIFIC EQUIPMENT

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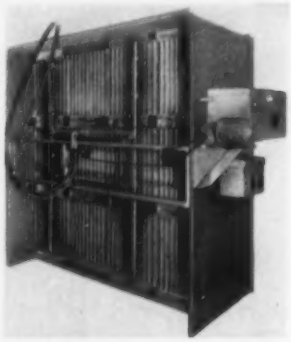
3 to 4 psig — for all flows. Cooling water enters steam at the seat of the orifice, the point of highest pressure drop. With the ball in concentric position, the incoming steam flows uniformly around the periphery through which cooling water is introduced. This is aided by the aspirating effect created by pressure drop in the steam passing through the annular restriction. The result is high turbulence regardless of flow rate, says manufacturer, with instant and intimate mixing of cooling water into the steam. Using a temperature controller with both proportional and reset features, the variable orifice desuperheater is reported to hold temperature within ± 5 F. Final temperature may be as low as 10 F above saturation temperature. The desuperheater is available for pipe line sizes from 2 to 14 in., for pressures to 2500 psi. Copes-Vulcan Div., Blaw-Knox Co.

28—AIR CLEANERS are high capacity electronic units

The Hi-C line of high capacity electronic air cleaners is announced for installation in commercial and industrial forced-air heating, cooling or ventilating systems. These cleaners are said to

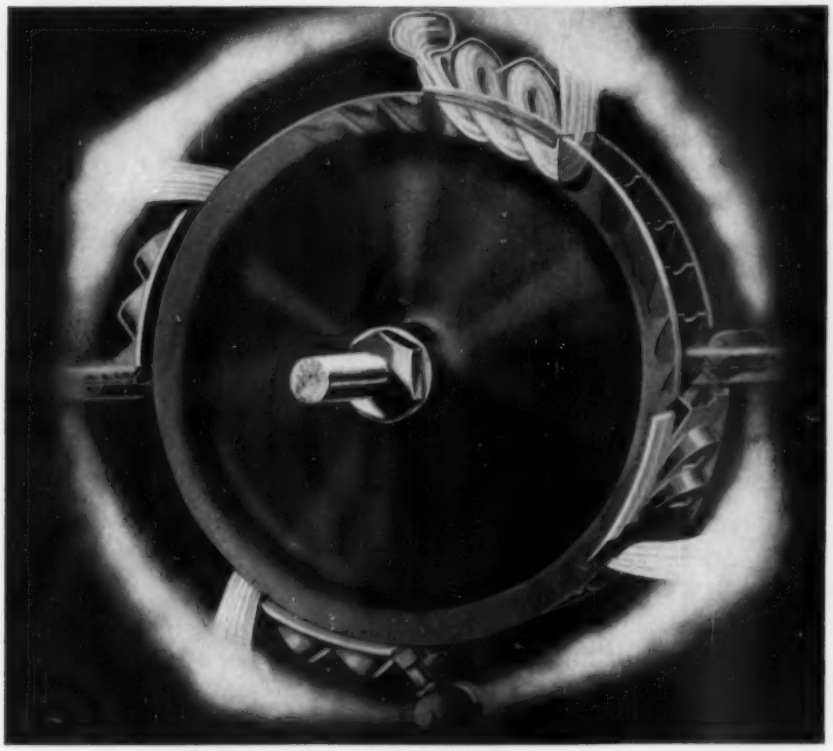


remove up to 97 per cent of the dust, dirt, pollen, smoke and other particulate matter. According to manufacturer, their design lets them operate with 40 per cent less face area than many units of the same capacity. This design principle permits the firing of the ionizing electron barrage against the "inside curve" of the negative electrode to create an area of intense ionization instead of a line of ionization. The result is increased ionization, more dirt particles electronically charged to be picked up by the collecting plates, it is explained. The cleaners come in a wide range of capacities, in horizontal or vertical flow models, and can be equipped with automatic or manually controlled self cleaners. Electro-Air Cleaner Co., Inc.

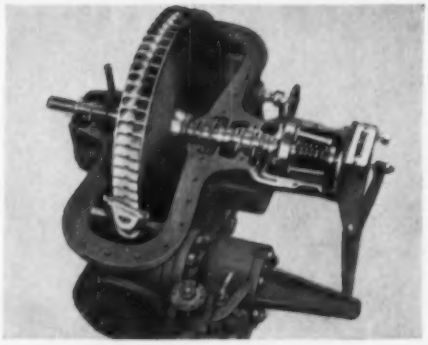
29—CONTROL VALVE is lever-operated, adjustable cam type

The Type 235 is announced as a redesigned adjustable cam, lever-operated valve for metering control of fuel oil in industrial oil burner installations. It is designed to control and maintain a certain flow ratio between two variables, such as air and fuel oil into an oil-fired steam boiler. It may be used where flow of two fluids must be kept within specified ratios such as the control of steam for atomizing fuel oil, control of steam-driven blowers or stokers, or control of gas-air ratios to burners. Atlas Valve Co.

TURBINE BLADES CAN'T FOUL!



The Terry solid-wheel turbine is of the impulse, helical flow type. The steam issues from an expanding nozzle at high velocity and enters the wheel bucket where its direction is reversed 180°. As this single reversal uses but a portion of the available energy, the steam is returned to the wheel several times until practically all of the energy has been utilized. This principle makes possible the efficient use of steam in a single-piece, almost indestructible wheel.



TERRY

TT-1206

Terry solid-wheel design permits large clearances

In the Terry solid-wheel turbine, the steam enters the buckets in a direction at right angles to the shaft, as shown above. This design eliminates the need for close clearances and provides positive blade protection.

The blades cannot foul. There is a one inch clearance on either side of the wheel. In addition, projecting rims on each side of the buckets prevent damage to the blades even though external thrust should move the wheel.

This is only one of the many advantages of Terry solid-wheel turbines. Write for complete details. Ask for a copy of bulletin S-116.

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

For more data circle 538 on Post Card

Pinehurst

tees off on fuel costs

Golfing resort cuts costs 33% with modern burning of coal

The central power plant at the famous golfing resort of Pinehurst, N. C., has to furnish a reliable supply of steam to three hotels and seven other buildings.

When Pinehurst recently decided to modernize power facilities, the consulting firm of Wiley and Wilson, Richmond, Va., was called in to study the situation. Since coal cost approximately 40% less than the nearest competitive fuel, the final decision called for burning coal the modern way. Today two new automatic stoker-fired boilers (only one of which is operated at a time) replace four 150-HP hand-fired boilers. Combustion control is automatic; coal and ash handling is greatly simplified. And now, according to management, "the cost of generating steam is 33.4% less than with the old plant."

Facts you should know about coal

Not only is bituminous coal the lowest-cost fuel in most industrial areas, but up-to-date coal burning equipment can give you 10% to 40% more steam per dollar. Today's automatic equipment can pare labor costs and eliminate smoke problems. And vast coal reserves plus mechanized production methods mean a constantly plentiful supply of coal at a stable price.

Technical advisory service

The Bituminous Coal Institute offers a free technical advisory service on industrial fuel problems. If you are concerned with steam costs, write to the address below. Or send for our case history booklet, complete with data sheets. You'll find it informative.

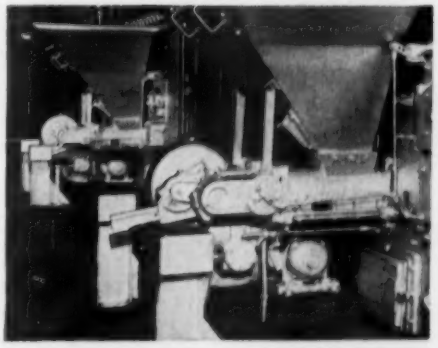
Consult an engineering firm

If you are remodeling or building new heating or power facilities, it will pay you to consult a qualified engineering firm. Such concerns—familiar with the latest in fuel costs and equipment—can effect great savings for you in efficiency and fuel economy over the years.

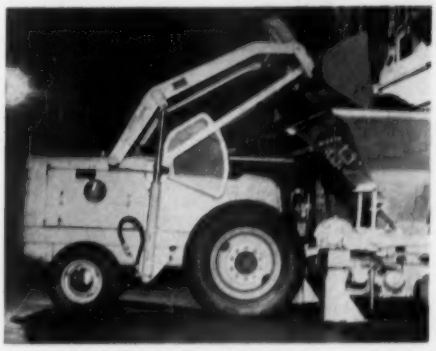
BITUMINOUS COAL INSTITUTE

Southern Building • Washington 5, D.C.

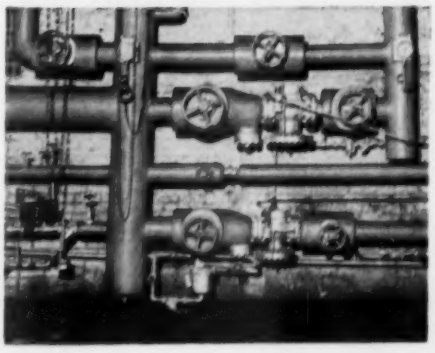
Two Babcock & Wilcox type FF integral-furnace boilers supply all the steam for Pinehurst at about 125 pounds pressure at 600° F. Average steam load is 11,000-12,000 pounds per hour per day.



Close-up of stokers. These underfeed, single retort, side-dump models are made by Detroit Stoker. They operate automatically, each driven by a 3 HP enclosed motor.



Frank G. Hough Payloader transfers coal from railroad trestle to storage, from storage to stokers. Payloader also facilitates handling of ash disposal.



Readily accessible, all of the steam distribution lines are taken off a manifold in the engine room. Five separate lines with Ruggles-Klingemann automatic pressure regulators distribute the steam at the required pressure in each case.

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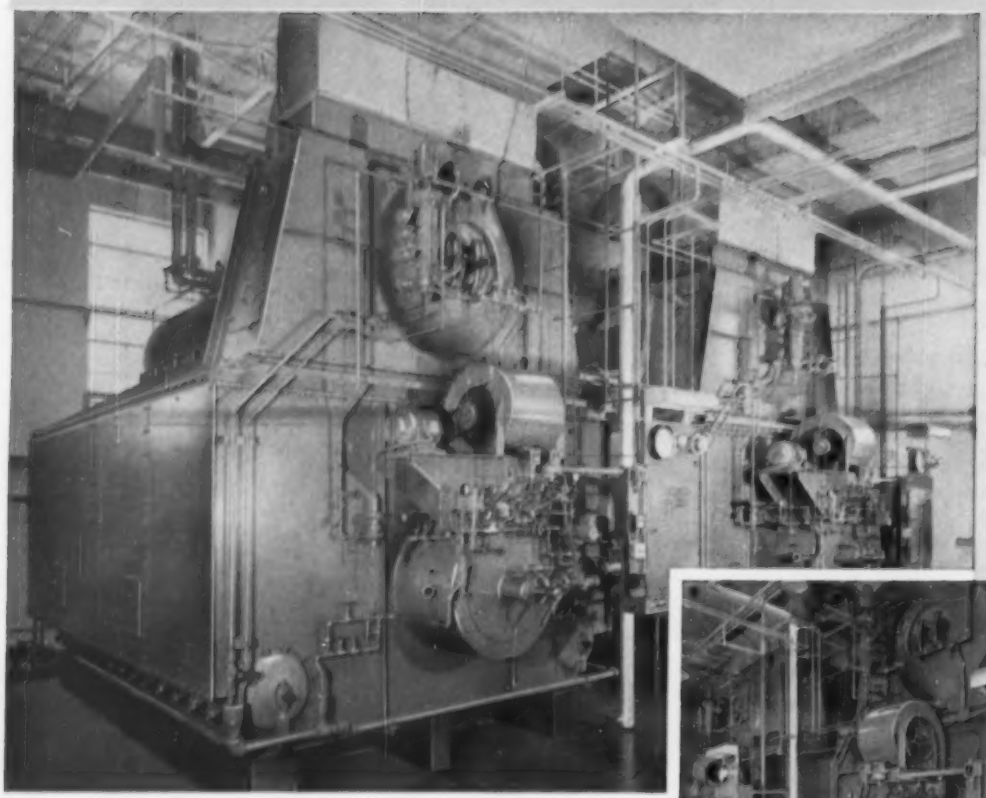
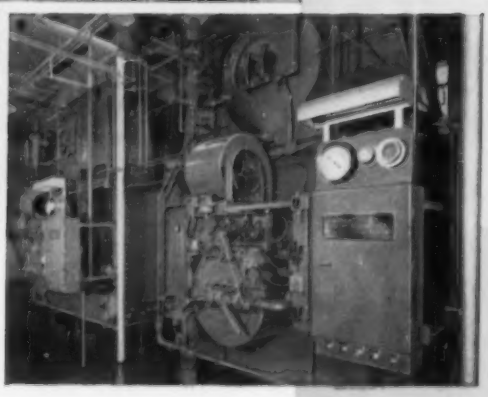
WICKES Type A, shop-assembled

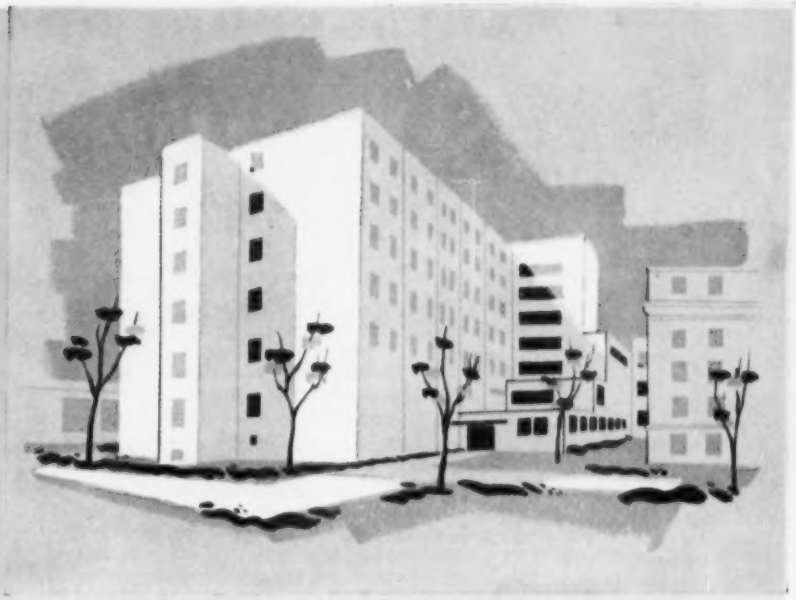
specified for the Edward W. Sparrow





Wickes Type-A Steam Generators combine custom engineering and shop-assembly to give you economical "packaged power" to exactly meet the load requirement. The entire unit is shipped complete ready to set on your foundation and installation can be made with minimum interruption of your production schedules. All necessary auxiliary equipment including trimmings, soot blowers, feed water regulators and other accessories, are shop-installed leaving field installation at a minimum. From the pressure-tight casing to the oil-gas burner, Wickes type-A water tube steam generators with capacities up to 60,000 lbs. of steam per hour are designed and engineered to be the standard of quality and performance in a variety of industries.

boilers are hospital



Architects sketch of new Sparrow Hospital.
Architects: O. J. Munson Associates–Lansing, Michigan.
Professional Engineers: E. Roger Hewitt Associates, Inc.–Lansing, Michigan.

One of the most important considerations in hospital construction specifications is the steam generation system, because it must give around-the-clock reliability without failure. It is significant, then, that for the Edward W. Sparrow Hospital in Lansing, Michigan, two Wickes shop-assembled Type-A Steam Generators have been installed to provide a dependable source of heat. The new units, which are housed, in a completely new boiler house, replace the original Wickes coal fired boilers. Each of these two new boilers are capable of producing 18,500 lbs. of steam per hour at an operating pressure of 125 psi. They provide 2250 square feet of heating surface and are equipped with fully automatic Wickes combination oil and gas burners. These units have a design pressure of 160 psi.

Write for our Catalog 56-1 for detailed information on Wickes Type-A Boilers, and we will also include our Bulletin 55-1 covering the complete line of Wickes Products and Facilities.

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BRIDGEPORT BRASS

COPPER ALLOY BULLETIN

CONDENSER AND HEAT EXCHANGER TUBE EDITION

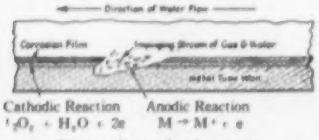
Pitting Corrosion: Causes and Cures

by C. L. BULOW
Bridgeport Brass Company

After a condenser tube is put into service, an extremely thin protective film forms on the inside of the tube acting as a barrier to corrosion. Occasionally this film is destroyed in localized spots and results in a condition called pitting corrosion. Pitting corrosion can be classified into impingement corrosion attack and deposit corrosion attack.

Impingement Corrosion

Impingement corrosion occurs when a high-velocity, turbulent stream of water removes the protective surface film and prevents it from forming, resulting in horseshoe-shaped pits that tend to enlarge and eventually cause tube failure.



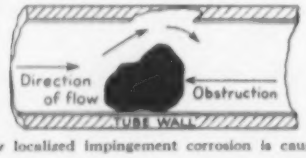
Pitting due to impingement

Impingement corrosion can also develop around pieces of debris lodged inside tubes which cause deflection of the flow against the tube wall, destroying the protective film.

Deposit Corrosion

Wherever bits of decomposing wood, cloth, fish, paper or other trash are in contact with a uniformly filmed surface, the protective film can be expected to break down and highly localized corrosion may start. This type of film-destroying attack is known as deposit corrosion.

Optimum operating conditions and regular maintenance, plus proper design, are the important factors in preventing pitting corrosion. In marine and power service, streamlining inlet piping and pumps, as well as larger water boxes, will help reduce turbulence and damaging water velocities. Keeping the tube sheet free of trash is also very important.



How localized impingement corrosion is caused

Suitable Tube Alloys

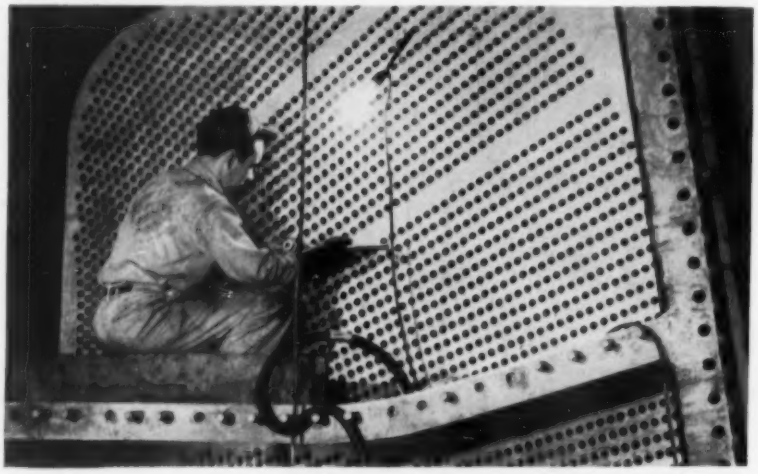
Wherever pitting corrosion is apt to occur, selection of the proper tube alloy is another safeguard to longer tube life and greater efficiency from your equipment. For high water velocities, Bridgeport Cupro Nickel 531, Bridgeport Aluminum Brass 54, and Bridgeport Duronze 53 are excellent choices.

How to Save Time, Money and Trouble When Selecting Condenser Tube Alloys

One of the maxims of condenser tube selection is that *there is no one all-purpose tube alloy for all operating conditions.* For this reason, Bridgeport makes a wide range of tube alloys so that individual operating conditions can be met more economically and more efficiently.

Application Requirements

Choosing the right alloy for your requirements depends on two things: (1) a knowledge of the specific operating conditions, including water compositions, temperatures, pressures, etc.; and (2) a systematic record of tube performance after installation. In the first case, the data is necessary to insure correct initial selection. The second type of record indicates operating changes which may require changing tube alloys when retubing.



When it comes to final selection of tube alloys, you may find that there are a number of alloys which can fulfill your requirements.

Arsenical Admiralty

One versatile alloy is Bridgeport Arsenical Admiralty 30. It is highly resistant to general corrosion, especially to dezincification.

In steam power stations, Arsenical Admiralty is used in surface condensers, auxiliary coolers and feedwater heaters.

On ocean, lake and harbor vessels, Arsenical Admiralty is suitable for boilers, auxiliary coolers and feedwater heaters where water velocities are low.

Aluminum Brass

One Bridgeport alloy gaining favor in recent years is Bridgeport Aluminum Brass 54. Its unusually high resistance to corrosion from both salt and brackish water has led to its increasing use in stationary power plants in place of Arsenical Admiralty, particularly in coastal areas.

In seaboard power stations, Aluminum Brass 54 has proved to be an excellent alloy for condensers as well as for coolers.

For marine service, especially on faster ships where turbulence is apt to be high, Aluminum Brass 54 meets a wide range of requirements in both exchangers and condensers.

Other suitable Bridgeport alloys for marine and power service are Cupro Nickel and Duronze 53.

For quick, on-the-spot help, contact your local Bridgeport Sales Office. There's one near you.

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Republic's solution provides each boiler with a *load*-sensing combustion control, a follow-up *pressure* control, and an "Electronic Master". In operation, a change in steam flow (load) is detected and initiates a proportional adjustment of air and fuel flow *before the load change can change boiler pressure.* Should pressure tend to drift up or down, the follow-up control detects it and modulates the fuel/air control signals accordingly. The "Electronic Master" integrates all measured data and master-loads the unit's pneumatic power operators. It also provides adjustable automatic division of total fuel among the boiler's 14 burners in the desired proportions, and permits manual operation.

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You Can Cure Slip-Ring Troubles

Here's a good solution to the problem of excessive wear often experienced with slip-rings on rotating machines. Shorts are cured, too, by making these simple modifications—in your own machine shop

By LLOYD McWILLIAMS*

MOST power engineers are familiar with an unusual erosion effect on the negative slip-ring of rotating-field generators and synchronous machinery. While many have experienced the trouble, apparently very few have found a satisfactory answer to the problem. This wear is attributed to a mild form of electrolysis between the material in the brushes and the metal of the slip-ring.

To balance the wear on the positive and negative rings, experience has proved it to be good practice to reverse the d-c leads about every two years.

Another difficulty that many in the field have experienced comes in the form of unaccountable flash-overs, or shorts, that burn off the pigtails to the brushes. Such cases of trouble usually result in a complete shutdown of equipment, and other troubles can be caused as secondary effects.

We have found a method which has proved most successful in eliminating flash-overs and slip-ring troubles in general. This technique is simply one of cutting several grooves in the face of the ring, with no change in brushes or holders. Figure 1 is a close-up photograph of a slip-ring into which three $\frac{1}{4}$-in. grooves have been machined, to a depth of $\frac{3}{16}$-in. The ring has been removed from the machine, and is still on the lathe.

At first thought, it might seem that by reducing the face contact area, more trouble can be expected. On the contrary, we have found that this simple expedient solves most of the more common slip-ring problems.

Fig. 1. Close-up of ring while on lathe

Actually, the decrease in surface area is about 37 per cent, as the total face width is 2 in. Of course, the current density is increased, but the transverse cleaning action helps attain better performance. Also, carbon build-up on the ring is eliminated, with its resultant pitting; and slightly better cooling results from the grooving of the face.

Figure 2 shows the slip-ring being machined in the lathe, using a conventional tooling arrangement. In Fig. 3 we see the revamped ring after it has been reinstalled on the machine, which happens to be a 15,000-kva generator. Sounds strange, but it works.

Many operators feel that slip-rings are not in good working order if they run slightly eccentric; just the reverse is true, however. With eccentric rings, the brushes will ride up and down in the holders and will not become fixed in one position. Thus, if the rings can be adjusted so they are slightly eccentric, a third common cause of slip-ring trouble can be avoided.

* Maintenance Supervisor, Shawinigan Water & Power Co

Fig. 2. Grooves being cut in slip-ring from 15,000-kva generator. These are ¼-in. grooves machined to depth of 3/16-in.

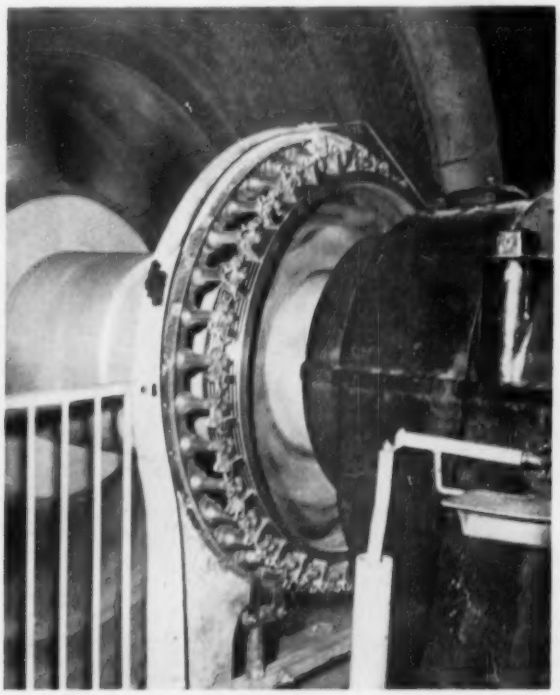


Fig. 3. Slip-ring back in operation on the generator. Same practice of grooving is used for large modern vertical units

Why Not Try Do-It-Yourself Control Panels

Labor-saving control centers can be built on the job for many remotely-operated motor loads, at low cost, using conventional devices—and a little ingenuity. Try a sample panel in your plant

By R. M. FRANCIS

HOW MANY MOTORS, fans, pumps, and other electrical devices do you have in your plant, which are located at distant points and require a lot of travel time just to start or stop? Perhaps an analysis of your electrically-operated mechanical equipment would immediately disclose a number of items that could be operated by remote-control, if the facilities were available.

In a system as basic as the air conditioning plant of a large office building, the fans, compressors, pumps, and other units are widely scattered over the building, in most cases. The start-up and shut-down procedures require travel from basement to roof in a conventional system. This takes time, and often requires the services of an extra person, plus some overtime labor. So why not consider the possibility of doing most of the operations by remote-control?

Starting with the simplest kind of system, let's say there is a compressor in the basement, and a large fan-and-coil unit on the top floor of the building, plus a roof cooling tower, or evaporative condenser. The system will be started-up in a certain sequence, and probably shut down in reverse order. Now, if these operations can be performed by pushing buttons in the power engineer's office, think of the time and steps to be saved. The addition of pilot lights will, of course, be required, to indicate whether motors are stopped or running.

Advancing from a simple start-stop system, other refinements can be added — if the cost is justified. Bearing-temperature indication can be had by the addition of thermocouples in the bearings, and an indicating thermometer on the control panel. Alarms of various types can be added if desired; temperature-sensing devices will indicate building zone temperatures, if their cost can be justified.

Standard Wiring Devices Used

Conventional stop-and-start buttons, pilot lights, motor-starters, and other wiring devices — plus a shop-fabricated panel — are all that's required to install a remotely-controlled system. A basic one-unit control system appears in Fig. 1, together with an illustration of the simple panel required.

Most motors of any size will be 220, or 440 v, but the control circuits will be 115 v; this calls for code wiring in conduit. The control-circuit wiring cost can be greatly reduced by using a 24-v system; no conduit is required, and the wiring is easier and faster to install. Control wiring of 24 v is quite satisfactory if the length of run is not excessive; however, the addition of *repeaters* will overcome the voltage drop in extremely long runs. If 24 v is used, instead of 115 v, the basic wiring diagram in Fig. 1 still applies; the step-down transformer would, however, have a secondary rating of 24 v.

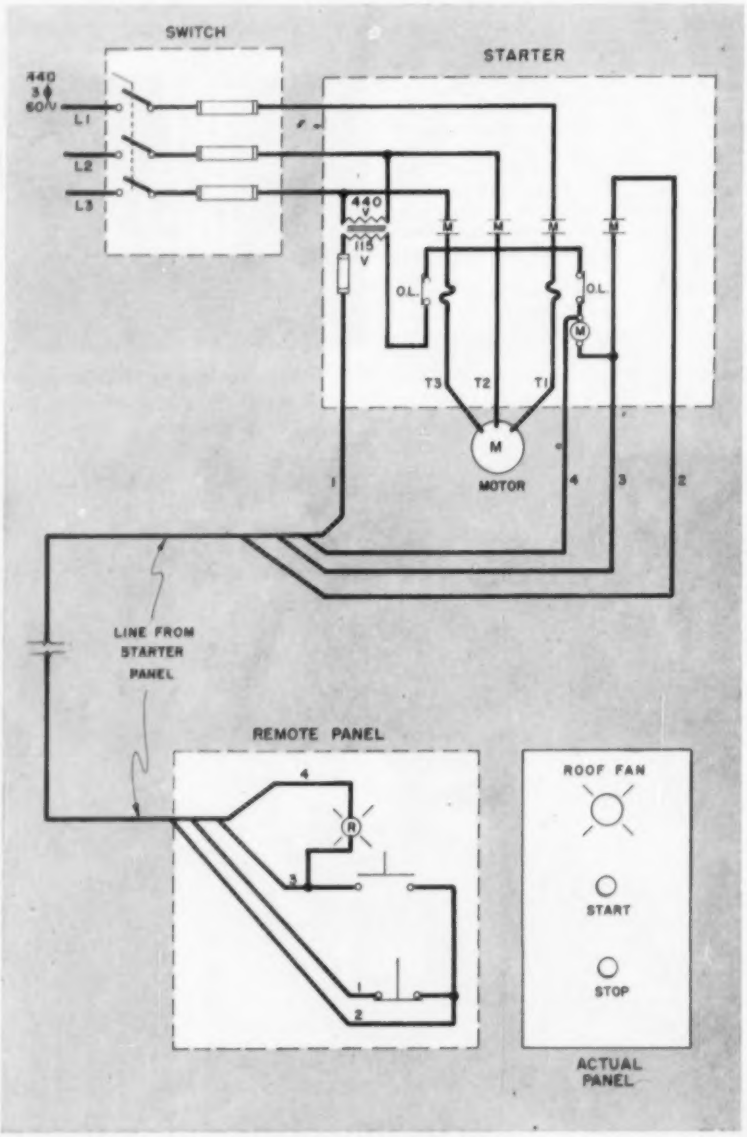


Fig. 1. Simplest of remote panels, used in connection with conventional motor-starter and safety switch. Starter and switch are required, regardless of location

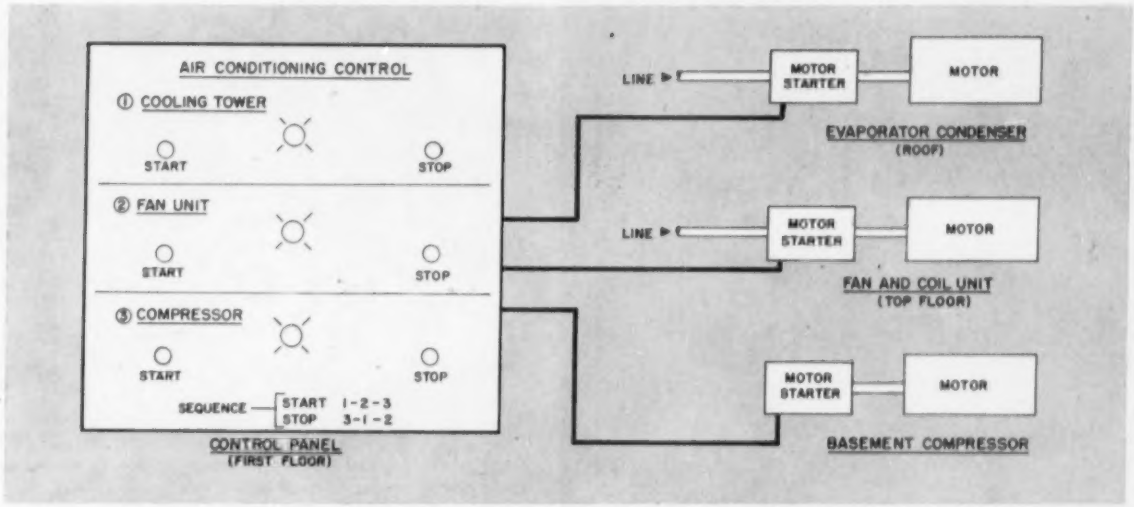


Fig. 2. Suggested layout of remote panel for controlling motor loads in basement, at top floor, and in roof penthouse

As the number of load points increases, the economy of operation becomes more interesting; the panel becomes more impressive, and more freedom is gained by the operating engineer for other duties. An illustration of a relatively simple three-load-point system is shown in Fig. 2. Here we have a compressor in one location, a pump in another, and a fan in still another. All of these loads are conveniently controlled from the central control panel in the power engineer's office, or any other location most convenient to operations.

The layout of the panel face should be such that additional features can be added when justified; or, a modular size should be pre-selected and additional panels added. Engraved nameplates are inexpensive and will enhance the appearance of the panel and give it a custom-built look. Such nameplates prevent confusion, and simplify the control system for new employees.

Panels can be made in your own shop, or can be made in any sheet-metal shop that has the equipment for making heavy gauge items of this nature. A baked enamel finish is desirable but not essential. If a definite sequence of operation is necessary, this can be graphically displayed on the panel, as shown in Fig. 2; this will help to prevent errors, and will permit an unskilled operator to start and stop the system in emergencies.

Up to this point, only the simplest of systems has been discussed, and they are truly do-it-yourself projects. From here, the job becomes more complex; the extent to which the system becomes remotely-controlled depends on several factors:

1. Cost of controls, wiring, and devices.
2. Savings in operating costs to be gained.
3. Engineer's knowledge of controls.
4. Actual value of added devices and controls.

Temperature indication is probably the second step to be considered for study. One danger in remote control of loads is that of infrequent, or uncertain, inspection of bearings, pump packings, and electrical equipment — all classed as preventive maintenance. Probably the one most important indication of temperature-rise desired is that of bearings; faulty lubrication, misalignment, and many other factors can cause them to become heated to the danger point. An indicating thermometer gives exact temperature readings, but this is not essential in all cases. An ordinary alarm circuit serves very well if other factors are agreeable; or, this can be supplemented with a localized trip-out relay to stop the motor, or disconnect the power to the equipment involved.

As another step in a do-it-yourself remote-control project, the alarm circuit, with indicating lights, is probably the most practical. However, if a temperature indicator (or recorder) is available for other purposes, this can be installed on the control panel, to do double duty. If used, a selector switch must be installed in its circuit, to select the one point at which a temperature indication is desired. Figure 3 shows a typical remote-control system which incorporates these features:

1. Three "start" pushbuttons, and pilot lights.
2. Three "stop" pushbuttons.
3. Over-temperature alarm bell.
4. Indicating thermometer.
5. Selector switch.

There is one danger inherent in any remotely-controlled system; unless a rigid program of inspection, on periodic intervals, is maintained, there is a tendency to overlook the equipment being controlled. A routine inspection and preventive maintenance program must be adhered to.

Since the motor-starters and/or safety switches are required anyway, the cost of these devices need not be included in a remote-control project. Wiring cost can be inexpensive; start-stop buttons and pilot lights are over-the-counter items; also, the panel can be made on the job if necessary, and if proper tools are on hand.

From a simple beginning, the remote-control system can expand into a complex network of controls, wiring, instrumentation, and gadgets; but then it no longer belongs in the strictly *do-it-yourself* class.

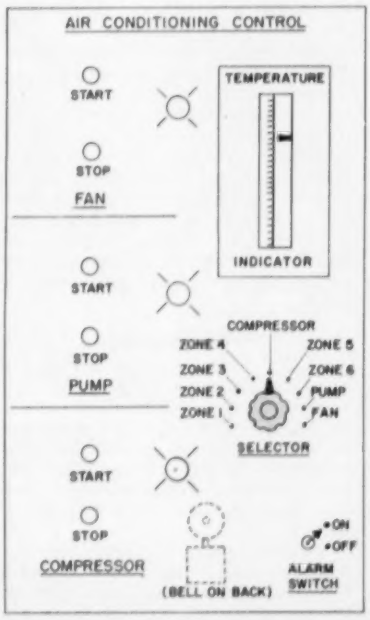
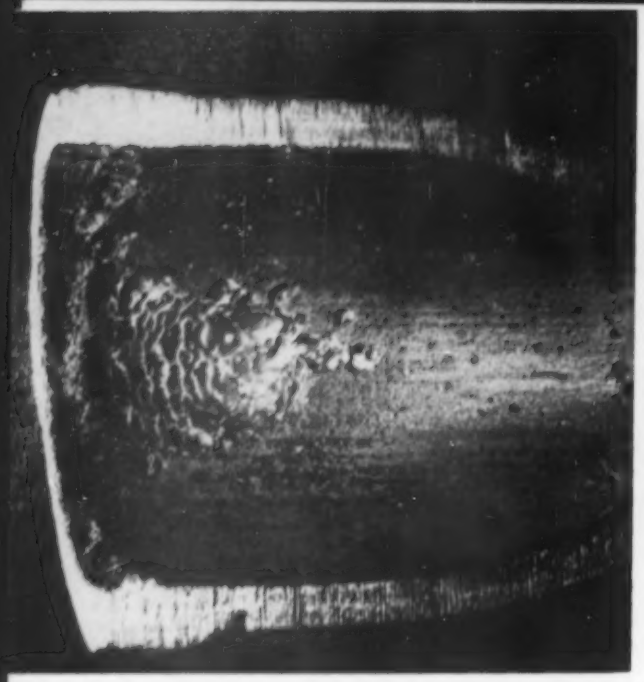


Fig. 3. Remote-control panel with start-stop buttons, lights and thermometer



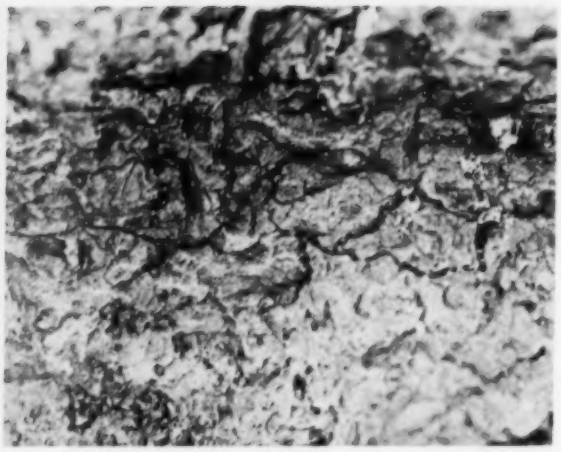


Fig. 1. (Left) Typical pattern of damage due to mechanical strain which cracks normal protective coating. Fig. 2. Enlarged view (30X) plainly shows cracking of brittle scale

Have You Ever Asked Yourself

Why Does That Particular

Author faces a challenging paradox, and asks: Can repeated pipe and fitting failures result from mechanical strains rather than the usual erosion and/or corrosion causes? He explains, gives you food for thought, and perhaps considerable relief from this bane

By FRED J. POSS *

MECHANICAL CAUSES are often a major factor in steel piping failures. Commonly diagnosed as corrosion, erosion, or pitting, with major emphasis on the chemical aspect, the real culprit can be just plain poor design of the system and/or lack of maintenance of the supporting members. With too little flexibility against thermal effects and inadequate restraints to oppose external forces, the piping strains itself to death.

What Happens

Think of steel pipe as having two separate functions: 1, the metal contains and supports the fluid, and, 2, a protective scale of oxide, carbonate, or other material inside the pipe separates the metal from its environment. Without this protection, steel wouldn't last long, even in ordinary water.

Unfortunately, the scale on steel is often brittle and is subject to cracking under strains that would be considered quite modest for the metal proper. This concept of a hard brittle coating on steel is an important one. The reader must bear it in mind to aid in understanding the localized pattern of failures usually observed in piping systems.

Many have become so used to thinking of pipe corrosion in terms of chemical reaction or erosion that some rather obvious paradoxes are sometimes overlooked. How many readers for example, have experienced failures in a particular fitting, and replaced said fitting only to have it fail again and perhaps again? Elsewhere the pipe seems to have marvelous corrosion resistance but at this one location there is constant trouble. Chemical corrosion and erosion do not satisfactorily explain the failures of a pipe elbow *and* its replacement if three other identical elbows at different locations in the line are undamaged over the same period. Corrosion and erosion are not that inconsistent or selective without a reason.

How It Works

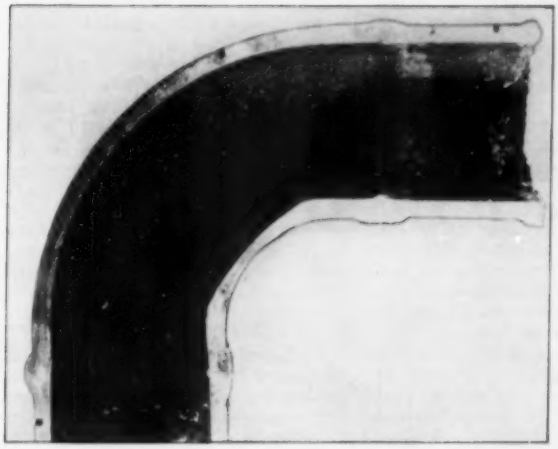
Piping in power and process plants is not static or motionless. It expands and contracts and may even sway in the breeze if maintenance is not up to par. All this means that stresses occur and the resulting strains, while not always damaging to the metal, may crack or spall off the protective scale. After a number of cycles of scale cracking, repair, and more cracking, a pattern develops like that seen in Fig. 1. The rippled bottom of this cavity has been diagnosed by many as typical of erosion but the actual liquid velocity in the line was less than one ft per sec. There were three other identical elbows in this line, same flow, same fluid, same temperature, that showed no evidence of damage over the same operating period.

Figure 2 is an enlarged view (30 X) of the scale in the corroded area of Fig. 1. The cracks in the scale are plain at this magnification. The line containing this elbow had a known history of cyclic deflection during operation. It swayed considerably.

Figure 3 shows an elbow that developed a leak near the inside radius of the bend. This might give rise to some head scratching on the part of those of the erosion school but it's not hard to explain in terms of stresses since these are not confined to any special point on the fitting circumference.

Modifications or changes of equipment are not uncommon in a process plant, particularly a new one. The required piping changes are made

* Supervisor, Materials and Processes Engineering, Atomic Power Dept, Westinghouse Electric Corp, East Pittsburgh, Penna.



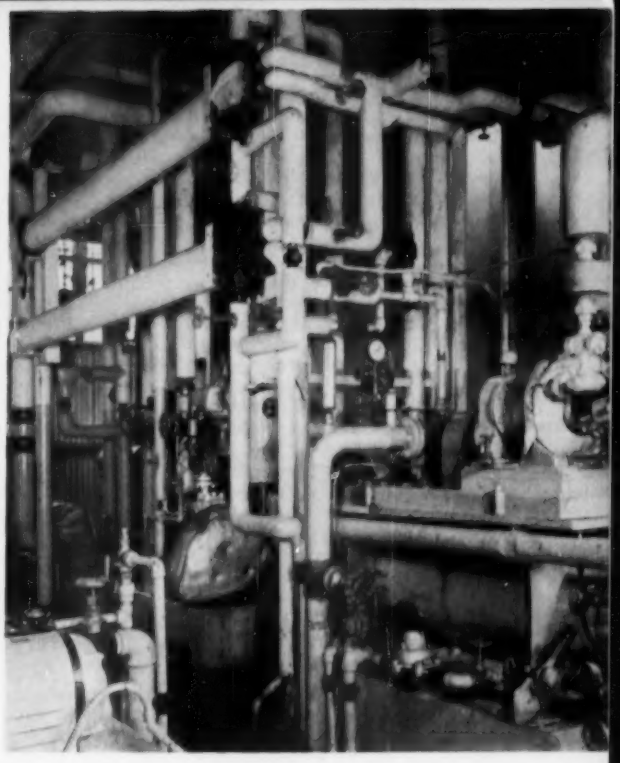


Fig. 3. (Above) Damage such as this is difficult to explain as corrosion or erosion. Fig. 4. Typical piping area. Damage to fittings here can be avoided only by proper design

Fitting Fail?

to suit the new equipment, usually by maintenance pipe fitters, and the plant goes back on stream. The plant engineers have sized the pipe to handle the required gallons per minute and maybe made it one size larger to hold down pressure drop. Perhaps someone has even reduced the length and number of fittings by eliminating a U bend or an offset — for reasons of economy. But now a rash of "corrosion" failures take place at or near the new equipment.

No one has consulted a pipe design engineer, who could have prevented all the trouble, because usually there isn't one available after the construction phase is finished. Thirty or forty per cent of the total plant capital equipment investment may be in pipe but rarely do we find an engineer who can do a stress analysis on the stuff. The writer has seen thousands of dollars spent on process stream analyses, inhibitors, long radius ells to reduce turbulence and substitution of stainless steel, etc, during the course of investigating such failures. Somehow, considerations of design and maintenance remain outside of the area of interest.

A pipe fitting creates some pressure drop or turbulence but it also concentrates line stresses very effectively. Pipe designers refer to this concentration as a stress intensification factor. It is literally a ratio of the section modulus in the fitting to that of the straight pipe run. For a 4 in., Sch 40 pipe elbow, this factor is 1.9. The worst situation occurs in reducing fittings where a large diameter line is suddenly stepped down to enter a pump or control valve. The author's experience shows that failures occur more frequently at large reductions in line diameter than at any other place in power and plant process piping. Table I gives approximate values of stress intensification for several sizes of commonly used reducers and elbows.

Stresses Are Unavoidable

There are two basic ways pipe can be stressed and a cantilever pipe beam will serve to show how it works.

The first is called constant loading or constant weight loading. We place 100 lb on the end of the pipe (beam) and it sags — perhaps 1 in. It is also stressed, say 20,000 psi max. Now, by increasing just the pipe diameter (thereby strength and stiffness) the 100 lb will cause less deflection and lower stress. This type of loading may result in plant piping where hangers or supports have failed or where construction or maintenance people use the piping lines to support scaffolding for compressors, welding equipment and the like. Dead weight loading should be avoided or minimized because pipe is very expensive

Table I. Approximate values of stress intensification for some common fittings

Diam (Sch)			Diam (Sch)		Section Modulus (I/c) Large	Section Modulus (I/c) Small	Factor (Stress Intensification) $\frac{(I/c)_{large}}{(I/c)_{small}}$
Reducers:							
1½	(160)	×	1	(160)	0.51	0.19	2.7
2	(80)	×	1	(160)	0.73	0.19	3.8
3	(80)	×	1½	(160)	2.22	0.51	4.4
3	(80)	×	2	(80)	2.22	0.73	3.1
4	(80)	×	2	(80)	4.27	0.73	5.8
4	(80)	×	3	(80)	4.27	2.22	1.9
6	(80)	×	3	(80)	12.23	2.22	5.5
6	(80)	×	4	(80)	12.23	4.27	2.9
Long Radius Elbows:							
1	(160)						1.0
3	(80)						1.28
6	(80)						1.58

and quite inefficient as a structural member compared to angles, tees, channels, etc.

The other loading that stresses pipe is the constant deflection type and this comes mainly from thermal expansion forces. For example, if a run of pipe had a 90-deg tie-in line entering through a tee connection, the thermal expansion of the tie-in would deflect the main run. Here, the situation with regard to stress takes a different turn. The stronger and stiffer the pipe being deflected, the more highly stressed it becomes. It can't restrain the thermal expansion thrust of the perpendicular tie-in line so it has to deflect as much as the product of: $a \times \Delta T \times L$ (for the tie-in line) dictates. (In this equation, a = thermal expansion coefficient; ΔT = temperature change; L = straight length of tie-in line).

Briefly, the stress in the pipe, for a given deflection, is proportional to the section modulus which in turn increases with diameter and, to a lesser extent, with wall thickness.

Corrosion troubles are too often countered by classical solutions; i.e., increased pipe wall, increased pipe diameter, change to stainless steel. All this, of course, increases expansion or strength and stiffness (and line stresses) when what we really need is increased flexibility.

Table II gives a set of data showing the effect of dimensions and materials on the stresses in a simple bend or offset. The data was obtained by the Tube Turns method of calculating combined line stress. The effect of diameter and material can be noted from Table II. Columns 3 and 4 indicate an 11 per cent reduction in combined stress obtained by going from 4 in., Sch 80 pipe to 3 in., Sch 80. The table also shows a stress reduction in going from 4 in., Sch 40 carbon steel pipe to 4 in., Sch 80.

This is not a contradiction of the earlier statement about wall thickness increasing stiffness; it does, but in the example used in Table II, the heavier wall results in a greatly reduced stress intensification (i) in the two elbows. In other words, the peak stresses have been reduced by distributing them over more pipe length and it is the peaks we are concerned about. Actually, the bad effect of increasing the wall thickness of pipe lies in the greater thrust the line will exert on other pipe and equipment tied into it as noted earlier.

Geometry or shape was held constant in columns 1 through 4 but its effect on flexibility is very great. Column 5 compares the offset in column 1 with one in which the "W" dimension is changed from 5 to 4 ft, and reveals a significant difference. Very often it is ignorance of the importance of this Shape Factor that causes trouble in piping when it's not designed but just put together.

To summarize, pipe and pipe fittings have certain functions to perform, and they can perform them well if given the proper opportunity. They must be properly sized, and of the proper strength. They must be well laid out, and installed in the proper manner. Then they must be used under conditions not exceeding the design data. Last but not least, they must be subjected to tight maintenance of the highest caliber, including the use of the necessary historical records to make cost comparisons possible.

Recommendations

1. Maintenance should include routine checking and repair of pipe supports (particularly spring loaded), anchors, sway braces, etc. to insure that the building frame is supporting the pipe and not the reverse.

2. Small changes in pipe layout to accommodate revised or re-designed process equipment should be done under the supervision of a competent piping engineer. In general, the shortest distance between two points is not the most economical in piping layout if maintenance cost is considered.

3. Don't oversize your pipe to save a little on line pressure drop. You'll have to reduce and enlarge for control valves and pumps and the greater the reduction ratio the greater the possibility of local failure from overstressing.

Table II. These figures demonstrate the vital effect of dimensions and materials on the stresses in a simple bend or offset

	Symbols	Units	1 Sch 40 Carbon Steel 4 in.	2 Sch 40 18-8 Stainless Steel 4 in.	3 Sch 80 Carbon Steel 4 in.	4 Sch 80 Carbon Steel 3 in.	5 Sch 40 Carbon Steel 4 in. W = 4 ft
Conditions:							
Operating Pressure	P	psi	400	400	400	400	400
Maximum Temperature	T Max	deg F	400	400	400	400	400
Minimum Temperature	T Min	deg F	70	70	70	70	70
Dimensions:							
H	H	ft	20	20	20	20	20
h	h	ft	12	12	12	12	12
W	W	ft	5	5	5	5	4
H h	L_s *	ft	37	37	37	37	36
Tables:							
Stress Intensification	i	Constant	1.92	1.92	1.42	1.28	1.92
Effective Excess Length	L	Ft/Elbow	4.7	4.7	2.6	1.6	4.7
Shape Factor	f_s	Constant	2.1	2.1	2.1	2.1	2.6
Number of Elbows	n		2	2	2	2	2
Effective Line Length $L_s + nL_e =$	L	ft	46.4	46.4	42.2	40.2	45.4
Max Temp Expansion Factor	f,Max	psi	77,100	107,100	77,100	77,100	77,100
Min Temp Expansion Factor	f,Min	psi	12,400	18,300	12,400	12,400	12,400
f,Max − f,Min Expansion Factor	f_e	psi	64,700	88,800	64,700	64,700	64,700
Outside Pipe Diam	D	in.	4.5	4.5	4.5	3.5	4.5
Flow Area	A_f	in.²	12.73	12.73	11.50	6.6	12.73
Metal Area	A_m	in.²	3.17	3.17	4.41	3.02	3.17
Bending Stress Due to Expansion $f_e \times f_s \times i \times D/L =$	S_e	psi	25,300	34,800	20,500	15,100	32,000
Longitudinal Pressure—Stress $P \times A_f/A_m =$	S_p	psi	1,600	1,600	1,040	870	1,600
Combined Stress	$S_e + S_p$	psi	26,900	36,400	21,540	15,970	33,600
Allowable Combined Stress-CODE	S	psi	24,000	25,800	24,000	24,000	24,000
Difference $S - (S_e + S_p)$		psi	−2,900	−10,600	+2,460	+5,130	−9,600
Stress Condition			12 per cent Overstress	41 per cent Overstress	10 per cent Understress	21 per cent Understress	40 per cent Overstress

* Square Corner Length

Note: Maximum allowable combined stress is taken from ASA Code for Pressure Piping, Para. 620 (g).

Handhole Gasket Failures Can Be Stopped

Handhole gasket failures are the exception, not the rule. But when the disease does strike, it can be serious. Good original workmanship, followed by thorough maintenance, will prevent and cure it

By H. M. RIVERS *

FREEDOM from gasket trouble in the past is no guarantee that it can't turn up later on. Leaks may develop slowly over a very long period of time and constitute no more than a minor nuisance to the boiler maintenance crew. Other times, a rash of leaks may develop so quickly as to put boilers, even whole plants, virtually out of service overnight. Even though the problem may not be acute in your particular plant, forces may be at work that can lead to trouble — possibly serious trouble — in the future.

If conditions are right, almost any major change in boiler water conditions can bring on an epidemic of leaking handhole joints. This happened in one plant when it switched from hot-process softening to deionization of the boiler make-up water. Numerous cap leaks have been known to develop shortly after a change in the type of internal treatment, sometimes when the change involved nothing more than the introduction of an organic dispersive agent. Simply improving the chemical control in dirty boilers may produce a rash of leaks at handhole joints.

Leakage of this type nearly put one large utility plant out of operation shortly after feedwater contamination with relatively acidic river water reduced the boiler water pH value to about 4.4.

In another case, a new boiler was re-gasketed following its initial acid cleaning, but not all of the handhole joints were made completely tight before metal sheathing was installed and hid them from observation; several months later, the boiler had to be taken out of service because many handhole gaskets had virtually disintegrated.

A similar case of gasket deterioration developed in a plant where gaskets had been mashed out-of-round and crushed in spots when caps were tightened on improperly machined header seats in a new boiler.

Mechanism of Attack

From the above remarks, it is clear that damage to handhole joints may be caused by a wide variety of things — so many in fact, that we might well despair of finding any features that are common to all and which can be kept under control.

Actually, the picture can be readily brought into focus by recalling a few things we know about the chemistry of steel and boiler water. Practically all boiler waters contain a little caustic alkalinity to assist in the prevention of scale and corrosion. This caustic alkalinity can become extremely corrosive to steel and gasket materials if allowed to concentrate excessively; and there is no doubt that caustic is responsible for the

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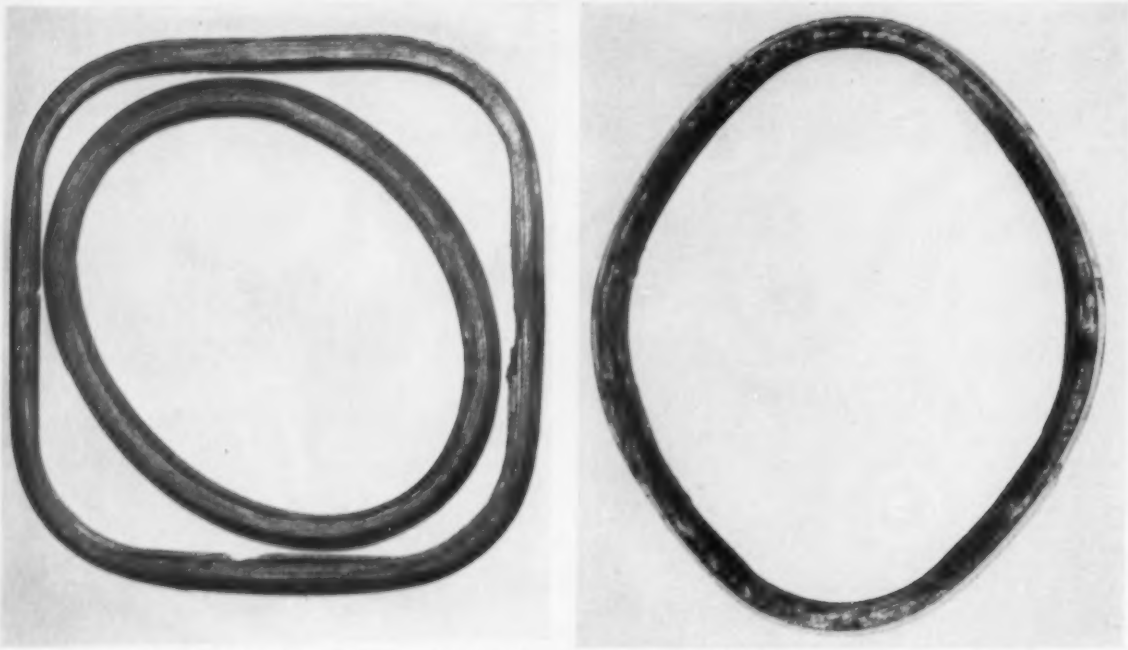
Fig. 1. This handhole cap failure was caused by severe corrosion when boiler water caustic concentrated at small leak

Fig. 2. Typical handhole cap removed from highly-corrosive service. Note extensive pitting around the entire perimeter



Figs. 3 and 4. Gaskets in which concentrated caustic has attacked both the asbestos and the stainless steel laminae

type of attack observed on gaskets and the header and/or cap seats where leaks have occurred.

On the other hand, since a great majority of boilers never experience more than a trivial amount of trouble with leaking caps, boiler water conditions in general, and boiler water caustic in particular, cannot be solely responsible for the difficulty.

Obviously, we are dealing here with a combination of chemical and mechanical factors: 1, a boiler water containing caustic that may become corrosive to steel if permitted to concentrate excessively; and 2, a leak within which boiler water solids may concentrate as steam flashes off at atmospheric pressure. The mechanism is simple. A leak of some magnitude, however small, must exist initially to get the process going. Some portion of the escaping boiler water flashes off as steam, leaving behind an increasing concentration of caustic. This caustic eventually becomes concentrated enough to attack the gasket and seat materials, thereby enlarging the openings and accelerating damage through the action of corrosion and erosion.

Prevention and Cure

Since there are many reasons why a certain amount of caustic alkalinity must be maintained in most boiler waters, the only remedy for this type of caustic corrosion is to keep the handhole caps from leaking in the first place. Imperfect fabrication of joints in the beginning must be blamed for the initial leaks that get things off to a bad start. Any leaks, however tiny, may develop into real trouble spots later on.

Considerable care must be exercised in machining the seats, aligning the gaskets and caps, and tightening the caps before and after the boiler goes in service. Whenever caps are removed, it is generally very poor practice to reuse any of the old gaskets, and both header and cap seats must be thoroughly cleaned and polished — resurfaced, if necessary — to remove all dirt, nicks or grooves created by previous leaking. Tightening the caps excessively may crush or distort the gaskets and cause serious trouble at a future time.

Some of the initial crevices may be so tiny that leakage through them is extremely hard to detect. To aid in inspecting for very minute leaks, a cold mirror or plate of polished metal, or even a jug of cold water, may be passed slowly around the joint. Appearance of moisture on the smooth, cold surface indicates the presence of a leak. Good maintenance men keep all handhole caps under careful observation for some time after a boiler is put on the line, and a program of routine thorough inspections of all handhole (and manhole) joints is highly advisable. Apparently trivial leaks that are unnoticed or ignored can lead to unscheduled boiler outages and costly repairs.

A great many incipient leaks probably become plugged with boiler water solids within a short time after the boiler goes in service. If all crevices remain sealed in this way, there can be no leakage nor consequent caustic attack, and the joints should remain sound indefinitely. However, if some major change is made in the composition of the boiler water, these chemical dams may be removed, allowing the leaks to reappear. Since crevices opened in this way may not again seal themselves quickly under the new condition, plant operators should be on the look-out for handhole leaks after any major change is made in boiler water chemical control.

Once a header or handhole cap seat has become scored as the result of a leak that went too long unattended, little can be done but throw the cap away and reface the header seat, which is usually a costly machining job. Sometimes gaskets made of relatively soft material can be obtained to compensate for irregularities on the surfaces of the seats. In many cases, however, this merely postpones the day of reckoning when time and money must be spent to put the seats back in shape. As an extreme, caps are sometimes seal-welded in place. That stops the leaks. It also stops a lot of other things in the way of boiler maintenance, inspection and cleaning.

Good workmanship in the beginning and a tight maintenance program thereafter represent the best — actually the only — completely effective solution to handhole gasket failures.

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Planning, Ingenuity Cut St. Joe Power Costs

Non-condensing, single-extraction turbines, new boilers, tailored to process steam needs and fuels available, meet expanded production demands, cut fuel costs per ton of paper at St. Joe Paper Co

By **ANDREW A. CUMMINS** * and **C. D. BASSETT** †

ST. JOE PAPER COMPANY of Port St. Joe, Fla., already had a paper-making capacity which some months averaged as high as 425 tons per day when, in 1951, it was decided to install additional equipment which would increase this capacity by 800 tons.

Power plant expansion required presented an opportunity to make installations which would materially reduce the costs of process steam and electric power. That this opportunity was realized is evidenced by the fact that the oil used per ton of paper produced was reduced from 102.5 gal. to 87.5 gal. This meant a saving of about 4,600,000 gal. per year over projected consumption at the old efficiencies.

Major new equipment which contributed to this improvement in overall efficiency included two non-condensing turbine-generator units, five boilers, two closed feedwater heaters, a deaerating feedwater heater, a demineralizer, and all necessary auxiliaries. The story of the planning, selection and integration of this equipment with the existing plant is the story of one way that this company has taken a long step toward overcoming the effects of constantly rising costs.

In 1951, the power plant consisted of seven boilers and three condensing, double-extraction turbines driving 6000-kw, 0.8-pf generators. There was a hot lime phosphate feedwater treating system.

For make-up water and for general mill use, water was secured from eight 150-ft wells and eight 600-ft wells which had a maximum capacity of about 6000 gpm. Hardness was about 13 grains per gal.

The condenser cooling water was sea water taken from the bay, necessitating frequent cleaning of the condenser tubes, with high maintenance and undesired outages.

Turbine Generator Selection

Of the three 6000-kw generators, nominally rated at 7500-kw capability at unity power factor, two were purchased in 1937, the third in 1945. The turbines were originally designed for 600-psig 750-F steam at the throttle, with automatic extraction at 125 psig and 50 psig, and a back pressure at the exhaust of 2.5 in. of mercury.

Due to the speeding up of the paper-production machinery, the extraction pressures had been raised to 140 psig and 70 psig by 1951. These machines were then carrying around 11,800 kw average load with approximately 61,000 lb per hr of steam going to the condenser, the balance being extracted for drying paper, digester cooking, heating water, black liquor evaporation, and so forth.

Since process steam was required at 140 psig and 70 psig in large amounts and at 200 psig in considerable amounts, the question arose: Should one or both of the new turbines be condensing with double extraction, or one straight non-condensing with 140 psig back pressure and one non-condensing exhausting at 70 psig and extracting at 140 psig?

It was clearly understood that with the condensing unit there would very seldom be any steam exhausted to the atmosphere. On the other hand, it was also realized that since there were large demands for 140 and 70 psig steam there would be very little steam exhausted to the atmosphere even without the condenser. Further, a condensing double-extraction machine is not as efficient in overall Btu use per kwh generated as a back-pressure with extraction or a straight back-pressure turbine.

Comparison of figures derived from manufacturer's data is shown in Table I. This demonstrates a saving of 18,000 lb per hr in favor of the non-condensing turbines, which results in a saving in oil alone of approximately $68,000 per year.

Estimated added investment, for

*Cummins & Barnard, Inc. †Engineer with Cummins and Barnard, Inc, when article was written, now independent consulting engineer.

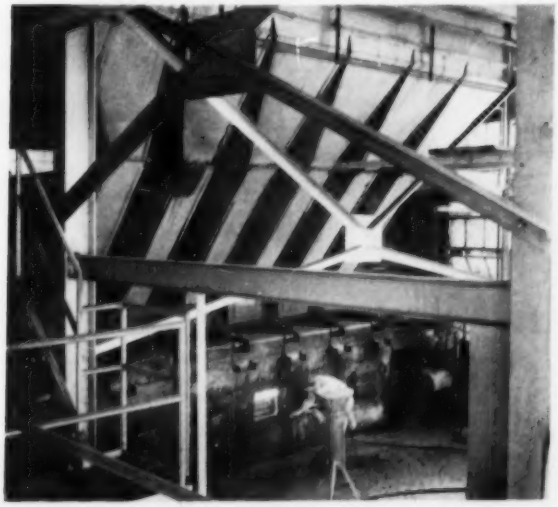


Fig. 1. Bark chutes and spreader stoker. Boiler also burns oil

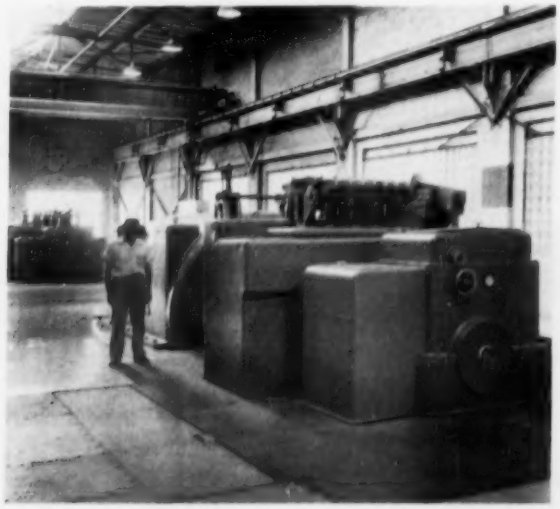


Fig. 2. Two new 12,500-kw units help raise overall efficiency

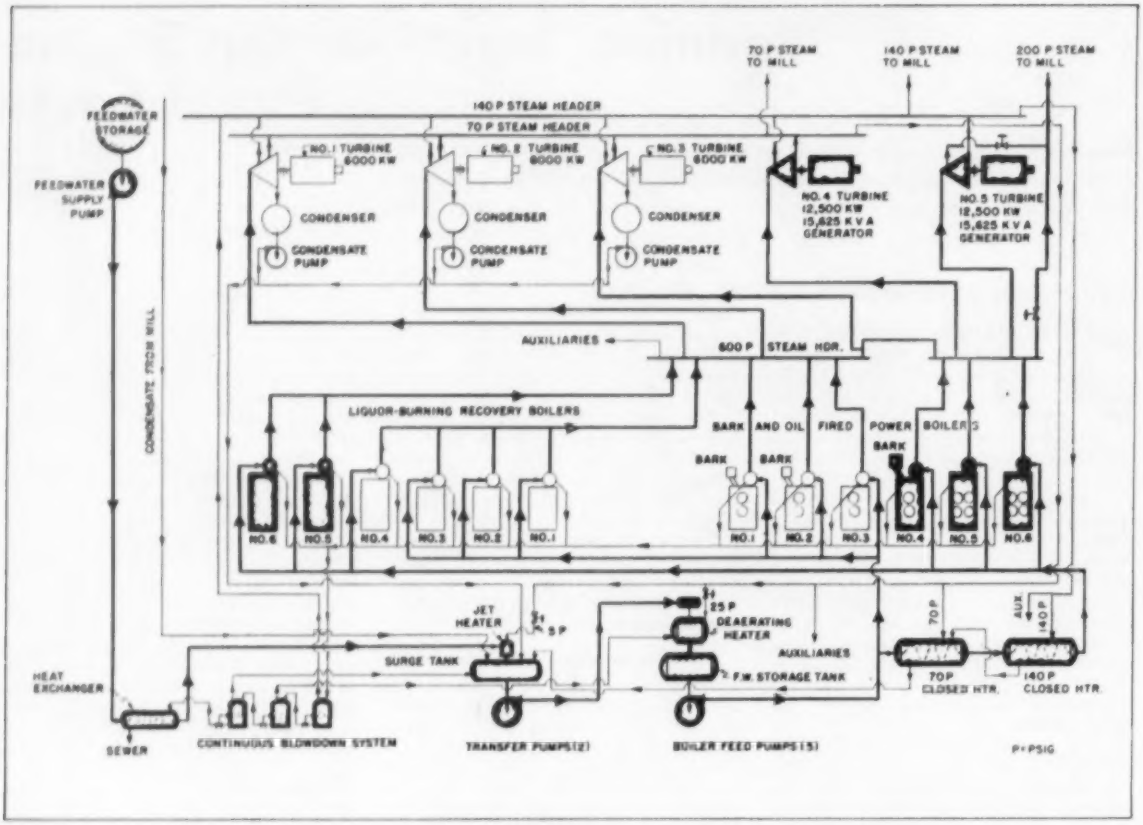


Fig. 3. Diagram shows feed water and steam flow to and from all principal items in the power plant. New equipment is darker

the condensing turbines, condensers, pumps, motors, piping and the extension of the intake system, over the non-condensing installation was approximately $250,000. While some of the condensing water could have been used where the heat put into it would be of value, this would have to be balanced against the increased power consumption of the pumps as well as increased maintenance in repairs and cleaning.

In summary, the non-condensing units save $68,000 or more per year and represent $250,000 less investment.

These new turbines are now used with two of the old 6000-kw double-extraction condensing units to handle the total mill load of about 31,000 kw, the new units usually carrying about 25,000 kw. Under these conditions the per cent of throttle steam ending up in the condenser is 5.7, compared with 16.5 before the mill expansion.

Since there were 8,300,000,000 lb of steam to the throttles in 1956, the possibility is readily seen of the substantial oil savings described above being realized.

This method of operation has made it possible to produce electric power requirements at a very low cost per ton of paper. It is believed to be as low as in any of the paper mills in the south, when fuel cost is taken into consideration.

Steam Production, 1951

Before the 800-ton expansion three power boilers were in operation, having been installed in 1938. Two of these burned bark and oil, the third oil only. The rated maximum capacity of each was 48,750 lb per hr of steam at 600-psig and 750 F. By modern standards they were small and relatively inefficient boilers.

These were augmented by four recovery boilers, three of which, installed in 1938, were rated at 47,600 lb per hr, and were also relatively small and inefficient. The fourth was a 1946 installation, produced about 90,000 lb of steam per hr from 250 tons of pulp based on high yield operation, and was quite an efficient boiler. Table II shows the principal characteristics of these recovery boilers.

After some study had been made as to the desirability of using 850 or possibly 1250 psig for the pressure for all new boilers, the management decided that it would prefer to continue to use the 600-psig pressure which was already in use. This avoided a dual-pressure plant and assured simpler operation, but did sacrifice economy that would have been possible with higher pressure and temperature. With somewhat higher steam pressure and temperature all electric power could have been generated as a by-product of process steam without any condenser operation whatever, and with less than one per cent of the steam exhausted to the atmosphere at times of breaks, etc.

New Power Boilers

A new boiler of sufficient capacity to generate 110,000 lb of steam per hr when burning bark and 150,000 lb when burning oil was installed together with a stoker and a live-bottom bin for handling and feeding the bark to the stoker distributors.

The efficiency for the new boiler operation was predicted to be 85.6 per cent when burning oil and 75.3 per cent when burning bark. It has been found that these efficiencies and rated capacity when burning bark have been attained.

But the operation of this boiler has not been without difficulties. At high rating a high temperature exists in the cinder return system, the temperature reaching a point where the nozzles burn next to the tubes on the outside of the furnace, requiring a shut-down for nozzle repair. This trouble has not yet been entirely eliminated.

There has also been a wear of tubes

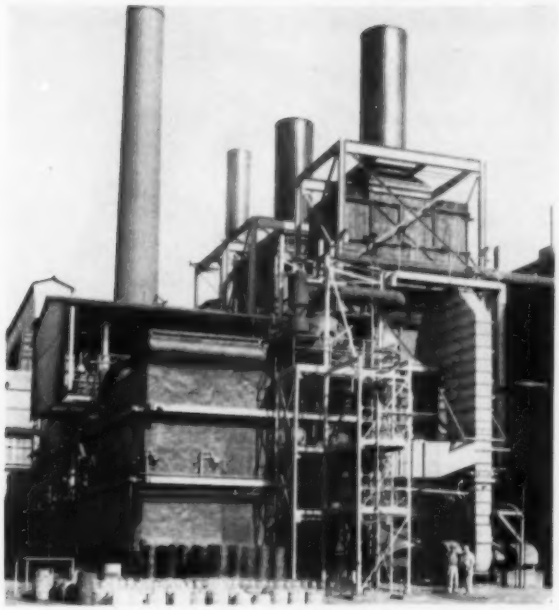


Fig. 4. Exterior view of oil-fired, pressurized-furnace boiler

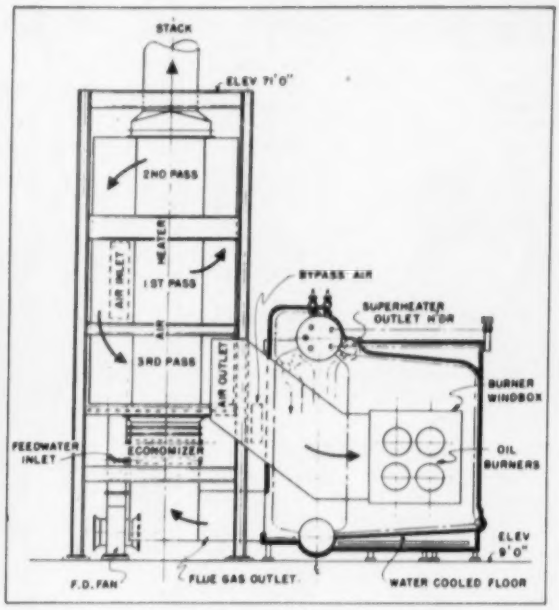


Fig. 5. Diagram showing section of the power boiler in Fig. 4

due to the bark sand carried in the gas stream. The seriousness of this has been reduced by installing plates on the front side of some of the tubes and installing additional baffles at chosen points. However, there are still some failures of tubes due to sand erosion.

Oil-Fired Boilers

After considerable study it was decided to install two pressurized furnace oil-fired boilers with 200,000 lb per hr continuous steaming capacity and a peak capacity of 230,000 lb per hr, steam conditions from the superheater being 625 psig at 760 F.

The difficulty experienced with these boilers has been the failure of tubes due to overheating, because of internal deposits which occur in spite of the fact that the feedwater comes from a demineralizing system. These deposits occur in restricted areas about 4 ft above the floor of the furnace and are apparently due to a too-high rate of evaporation at this point which together with other factors causes a heavy drop out of scale-forming material.

More strict control of water treatment, periodic acid cleaning and reduction of the steam load at which the boilers are carried has reduced but not entirely eliminated the bulging of tubes.

An analysis of the scale found at the points of failure showed that it did not consist of ordinary calcium and magnesium sulphate and carbonate scales but of iron, sodium, aluminum and silica compounds, making for the most part a very hard scale with a low rate of heat transfer.

At the tube bulges the scale reached a thickness of 0.036 in. of which 0.008 in. was a soft brown coating next to the water and 0.028 in. of a dark, hard, brittle scale next to the tube metal. Observation showed that 5 ft down from the bulge there was only about 0.005 in. of scale. This suggests that although the scale-forming materials in the boiler feedwater are of small quantity yet if they all tend to drop out within a short length they will soon build up, decreasing the heat transfer to the point where failure occurs.

The contention that such a phenomenon is peculiar to these oil-fired boilers is supported by the fact that there are ten other boilers operating at the same temperature and pressure with the same feedwater, in which such tube failures have not occurred. It can be correctly stated, based on thermocouple readings, that if the feedwater were 100 per cent pure there would be no tube failures but given even a very small amount of the above materials, concentration of

Table I. Steam data, condensing and non-condensing units

	As bought		Considered
	T-G Unit #4	T-G Unit #5	T-G Units A & B Each
Steam Quantities, lb per hr			
200 psig extraction	—	50,000†	25,000
140 " "	"	—	174,000
70 " "	—	—	137,000
140 " exhaust	—	348,000	—
70 " "	274,000	—	—
27½" vacuum exhaust	—	—	9,000
Kw by 200-psig extraction	—	850	425
Kw by balance of steam	12,500	11,650	12,075
Total kw	12,500	12,500	12,500
Total steam to throttle	274,000	398,000	345,000

† Uncontrolled * Controlled

Table II. Characteristics of the chemical recovery boilers

	Old		New
	Boilers #1, #2 & #3 Each	Boiler #4	Boilers #5 & #6 Each
Capacity lb per day dry solids—salt cake free	359,000	700,000	900,000
Tons of pulp per day	130.5	250	350*
Design pressure, psig	650	670	700
Steam operating pressure, psig	615	625	625
Steam operating temperature, F	725	725	760
Average steam flow as operated	47,600	90,000	140,000

* Based on 2600 lb of liquor solids per ton of dry pulp

scale occurs and the tubes fail.

Since analysis of this scale by a well-known feedwater treating company showed it to be 30 to 40 per cent iron oxide and analcite, the latter consisting of a sodium, aluminum and silica combination, very close control of the demineralizer is required to give a minimum of aluminum and silica in the effluent, and reduce all chances of iron pickup to a minimum.

With these scale-forming materials kept at a point where no more than 0.005 in. to 0.008 in. of hard scale would build up in one year, which would engender 750 F tube temperature on the fire side with an input of 150,000 Btu per sq ft, and if the boilers were cleaned once per year, it is expected that there would be no more tube failures.

Recovery Boilers

Two new recovery boilers having a capacity of 900,000 lb of dry solids per 24 hours each were installed.

This performance was based on 625-psig operating pressure at 760 F, a total heating surface of 40,620 sq ft, and on 52 per cent solids in the liquor to the recovery boilers from the multiple-effect evaporators. On the basis of one ton of dry pulp for each 3000 lb of liquor solids, the capacity in tons of dry pulp for these boilers was 300 tons each. Due to hot stock refining at this mill, a ton of air-dried pulp is secured for each 2600 lb of liquor solids, which increases their capacity to 350 tons each per day, so these boilers have come up to expectations.

Each of the recovery boilers is equipped with an electrical precipitator which was guaranteed to remove 93 per cent of the suspended matter in the gases entering the precipitator. The suspended matter is dry dust and fume, principally sodium sulphate.

The recovery boilers receive black liquor from the multiple-effect evaporators at 52 per cent (plus or minus) of solids and after passing through the cascade evaporators the liquor going to the furnace has 65 per cent (plus or minus) of solids.

Feedwater Treatment

The water supply for the mill which was installed at the time of the expansion was described by the authors in the May (1957) issue of POWER ENGINEERING, in an article titled St. Joe Paper Gets New Water By Long Distance. The water originates in the Chipola River, and at times there is high turbidity and considerable color. It is supplied to the mill through an open canal most of the distance, which is some 17 miles.

Treatment of this water for mill use, and before going to the demineralizer filters is with chemicals introduced at the inlet to one of the culverts four miles from the mill, through which the velocity is 3.3 fps, insuring good mixing. From the culvert the water discharges into a canal of large cross section where coagulation and *continued on page 120*

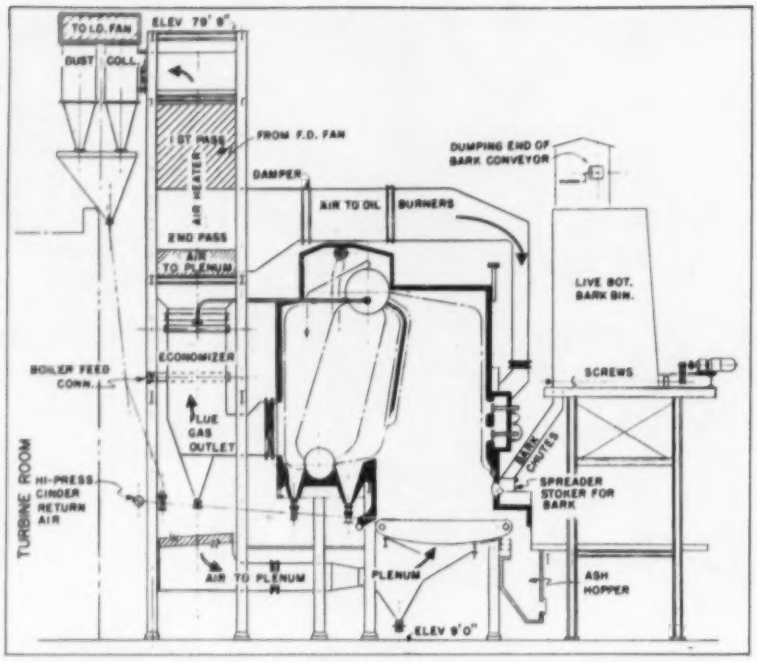


Fig. 6. Section showing bark- and oil-fired boiler and bark handling equipment. Capacity is 110,000 lb of steam per hr with bark, rises to 150,000 lb with oil

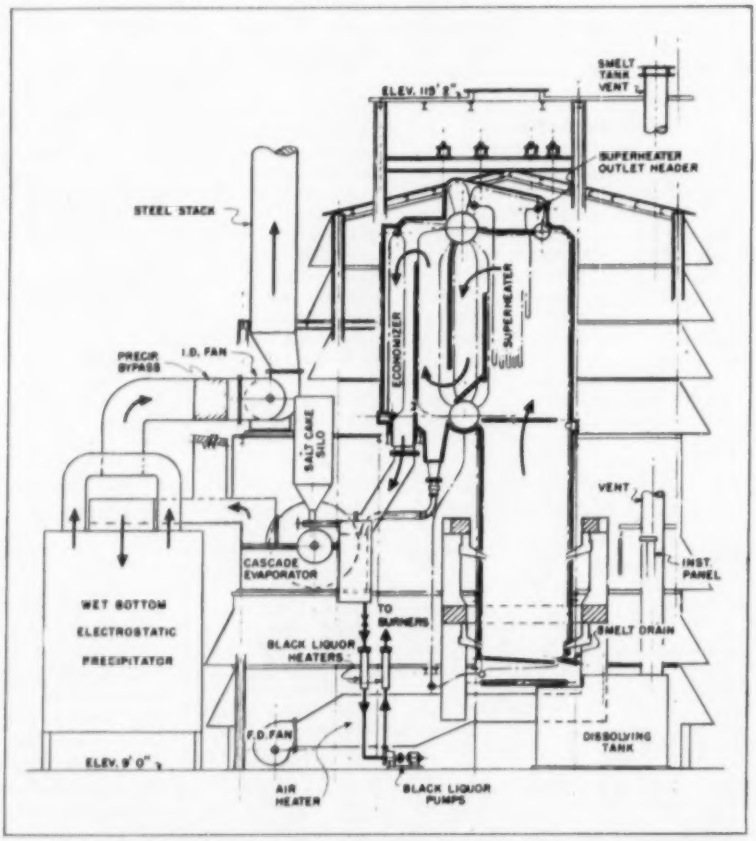


Fig. 7. Cross-section of chemical recovery boiler and pertinent auxiliary equipment. Cascade evaporators concentrate liquor to furnace to 65 per cent solids

Gas Turbines March On

New prime mover acquires records for efficiency, dependability, versatility. Combination cycles with steam turbines offer overall efficiencies equal to critical-pressure plants at lower cost per kw

NEW 16,000-KW gas turbine is the heart of the world's highest-capacity industrial floating power station, recently completed for service on Lake Maracaibo, Venezuela. This totally self-sufficient plant is designed for automatic and remote-control operation, and will burn natural gas, readily available in the oil fields, with provision for switching to distillate oil when necessary.

The simple-cycle single-shaft turbine is the latest in the parade of gas-turbine prime movers which are generating power, pumping fluids, compressing gases, and moving ships, trains and planes in ever-increasing numbers throughout the world.

The last decade has seen several hundred gas turbines built and installed in North and South America. Their owners are coming back for more. They like the rugged, dependable machines.

There are three main reasons why the gas turbine has so rapidly achieved the status of maturity as a prime mover: it is efficient; it is reliable; it is versatile. And it has proved itself on all three counts, in operating experience that amounts to hundreds of turbine-years in the western hemisphere alone.

New installations are compiling increasingly attractive records. Units now under construction or in the planning stages are larger and/or more efficient, and the latest systems promise remarkable economies.

The gas turbine, now widely accepted as a prime mover in power generation, in industry, and in land, sea and air transportation, is to be found fueled by gas, by oil, and by coal, and is considered a prime prospect for use in connection with a nuclear reactor. Even its use with solar energy as a source of heat is being discussed.

Economy in Combinations

In Cordele, Georgia, next March, the first plant originally designed as a combined-cycle steam-turbine, gas-turbine plant is scheduled to go into operation, bringing new overall efficiencies into reach of a plant its size. A 5000-kw simple-cycle single-shaft gas turbine will exhaust into a 130,000 lb per hr boiler, to assist in making steam to drive a 12,500-kw steam turbine. The exhaust will also be used in drying and transporting the coal to the boiler, and in heating the feedwater. Both turbines and generators were built by General Electric.

The advantages of this sytem are not confined to small plants. J. O. Stephens, Westinghouse, points out that in a modern 150,000-kw steam plant of 1800-psig pressure, 1000-F initial and 1000-F reheat temperature, the overall plant efficiency may be improved five to six per cent by the addition of a gas turbine to the cycle. Further, original cost per kw capacity shows a decrease of about six per cent. These figures are for ambient air at 80 F, and become even greater as the temperature decreases, due to the increased mass flow of air.

Sufficient studies have been made both by manufacturers and consulting engineers to show that these gains are realistic and should be actively pursued.

The basic scheme for this combined system is shown in Fig. 2.

Use of gas turbines in power generation has grown from the original concept of a versatile peaking unit until it now is competing favorably under some conditions with both steam and diesel prime movers. One of the pertinent conditions is that low-cost gaseous fuel must be available. It is predicted, however, that improvement in the techniques of burning other fuels may alter this situation. Oil, of course, is widely used in various grades. Now in successful operation in Germany is a 2000-kw gas turbine unit with a coal-fired air heater as the heat source.

One of the largest installations of gas turbines for generation of electric power is being built on Vancouver Island, B. C. Contributing to the total capacity of 75,000 kw will be two 19,750-kw simple-cycle single-shaft units and two 18,000-kw regenerative-cycle single-shaft units. They were ordered from General Electric.

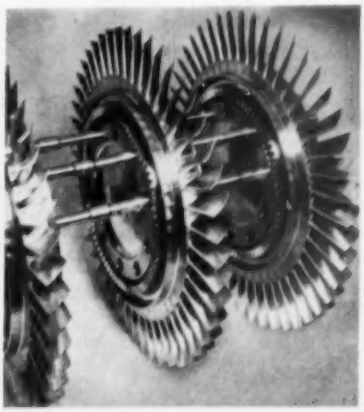


Fig. 1. Turbine rotor being assembled

Many Advantages

So simple to operate is a gas turbine plant that at Fort Stockton, Texas, a 5000-kw plant is operated by one man per shift, and a new unit scheduled to go into service in 1958 will not increase the manpower requirements. In other cases, complete remote control is being used.

A further advantage in this type of plant is that auxiliaries are few, holding down both initial cost and subsequent maintenance costs. The generating units are also flexible enough to handle large or sudden fluctuations of load, and have unusually high efficiencies at partial loads.

Two additional advantages of the gas turbine were pointed out when four 5000-kw units were ordered from Westinghouse by the state of Sao Paulo in Brazil. They were selected because of a serious water shortage in the area where they were to be installed, and because their mobility would make it possible to move them at minimum expense should it become desirable in the future.

Figure 3 shows the first of two 16,000-kw units before shipment to Monterrey, Mexico, where it will generate electricity for a complex of industrial concerns in that area. This simple-cycle single-shaft machine will burn natural gas as fuel, was manufactured by General Electric.

That company is also shipping a 21,500-kw unit of similar design to Caracas, Venezuela, which will use natural gas as fuel, but is designed for dual fuel operation, changing from gas to distillate oil as necessary. Provision has been made for completely automatic, unattended operation.

A second unit of like capacity for Caracas has been ordered from Brown-Boveri.

High-Powered Portables

The floating power plant mentioned above, which will be towed from place to place as it is needed in the oil fields of Lake Maracaibo, is mounted on a large barge, along with all pertinent auxiliaries, including high- and low-voltage switchgear, power and step-down transformers, and all controls. Its land counterpart is a 5000-kw railway-mounted unit which has just finished a year of testing, logging more than 5000 hours of operating time at Fort Meade.

This power plant is installed on two 54-ft long cars, which also contain all necessary auxiliaries, all of which were furnished by Westinghouse. The unit and all of the auxiliaries of the floating plant were of General Electric origin.

Other portable models include English Electric's unit, offered either with or without the regenerative feature. With the heater, the engine weighs 30,000 lb, develops 1910 kw with an efficiency at the alternator terminals of 22.23 per cent, at 59 F. When altered to operate at 32 F, it is capable of an output of 2125 kw, the efficiency rising to 25.63 per cent. The outline of this gas turbine and generator is shown in Fig. 5.

The reliability of the gas turbine in electric power production is impressive, and as the few early bugs have been worked out and the older machines are becoming a minute minority, the reliability factor is rising even higher. Figure 4 shows three Westinghouse units in a Venezuelan station which operates with no interconnecting ties or any other standby power. Substantiating confidence in the record of reliability which the three machines have established is the fact that a fourth unit has been ordered and will go into service soon.

The Gas Turbine in Industry

In industry, the gas turbine has been put to a wide variety of tasks. At Gates Rubber in Denver, a 5000-kw unit not only generates electric power but also supplies heat to make process steam in a heat recovery boiler. The chemical and petrochemical industries have put the gas turbine to work in applications too numerous to mention, but largely concerned with pumping and compressing fluids and gas.

A number of combination cycles are in use or being studied in these industries. These entail cases where gases are compressed by the compressor of the unit, used in the process, and discharged at elevated temperatures through the turbine. Typical of this application are nitric-acid plants, where several such installations are presently accumulating data.

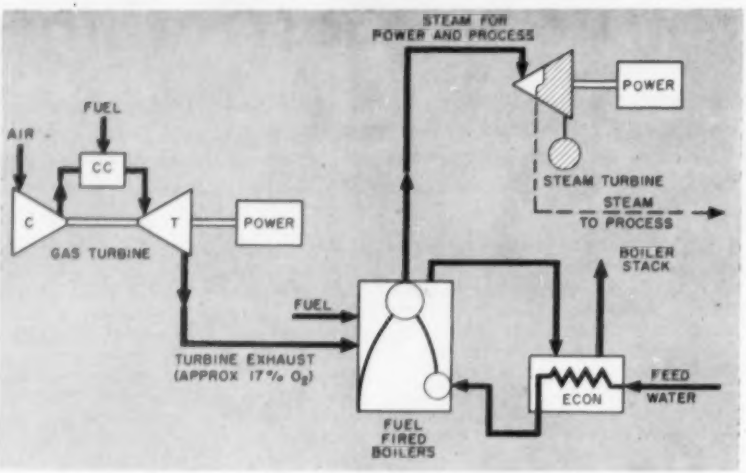


Fig. 2. Typical scheme for combination cycle of gas and steam turbines, making maximum use of all heat available in both cycles. Very high efficiency is attained

Having pumped natural gas long distances for some time, gas turbines were recently inaugurated into service pumping crude oil through pipe lines.

The first gas turbine to be used in the United States for supplying air in blast furnace operations will be delivered to U. S. Steel's South Works in Chicago next year. It will use directly the combustible gases usually drawn off and used to fire steam boilers, which drive steam turbines, which in turn drive compressors. The boiler and its auxiliaries, all of the feedwater cycle will be eliminated by this system. The initial cost of the equipment will be less, and the maintenance and operating expenses should be considerably lower.

World's Largest G-T Plant

World's largest concentration of gas-turbine power is on Lake Maracaibo, Venezuela, where twelve 8000-hp units are used to operate centrifugal compressors, injecting 300,000,000 cubic feet of compressed gas daily back into the oil fields beneath the lake. This plant, located on a platform seven miles out in the lake, took over the title of the world's largest from its neighbor, which has ten 6000-hp units. Both are the property of Creole Petroleum. A third plant is in the planning stage. It is expected that this procedure will improve the eventual recovery of oil from this field about one third.

Transportation

In the transportation field, the gas turbine has made no less, perhaps more of an impact. The success and universal acceptance of the turboprop and turbo-jet engines for aircraft propulsion are well known. These are nothing but air-borne adaptations of the gas turbine as we in the power engineering field know it, and propel most of the military and a growing section of the civilian aircraft in the air today.

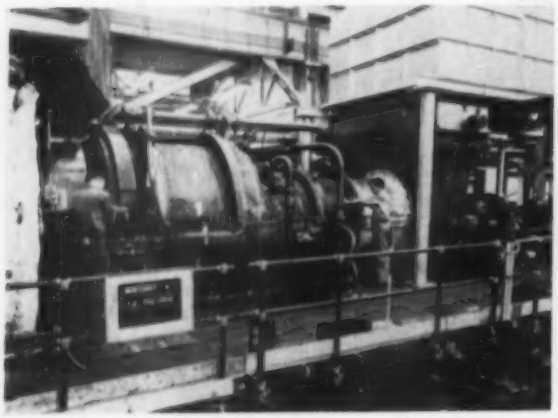


Fig. 3. 16,000-kw gas turbine for electric power in Monterrey

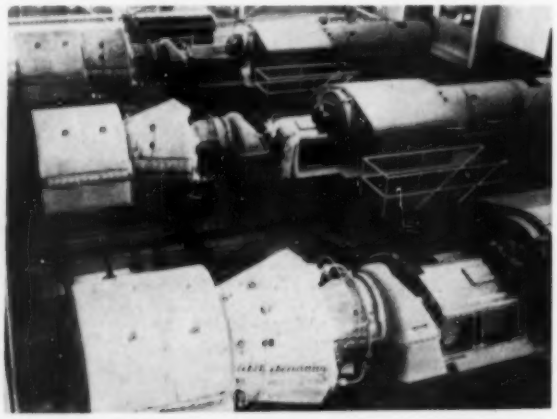


Fig. 4. Three Venezuelan gas turbines typify dependability

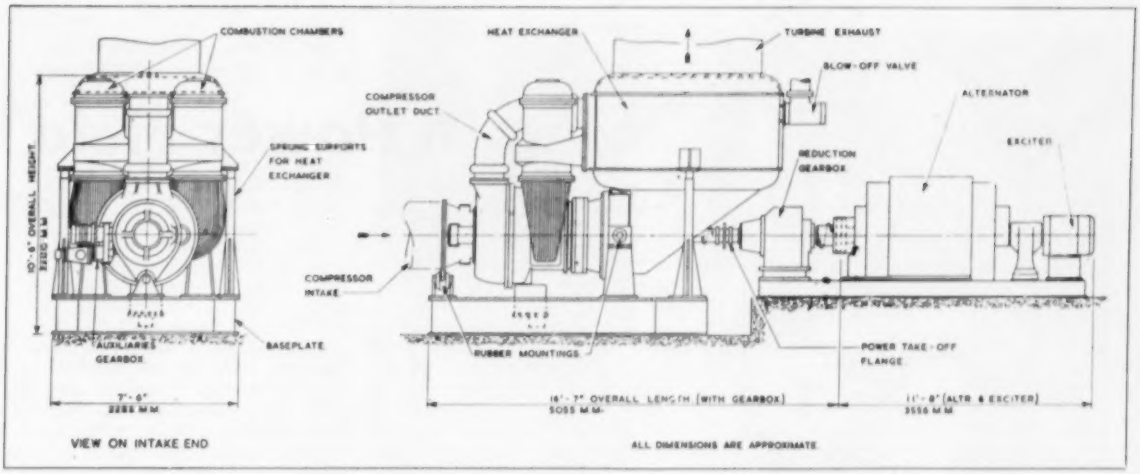


Fig. 5. English Electric 2750-hp gas turbine, shown with generator, is portable, highly-efficient. Note the unsplit casings

Advances in the machines on the railways of the nation have been equally as spectacular.

Union Pacific has 25 gas-turbine-powered locomotives in service between Council Bluffs and Ogden. The oldest has been in service since February, 1952. All of the 27 units (including spares) have been out for modification or repair at least once. In spite of this they have proved they can: 1, move freight faster; and 2, attain higher reliability, than any other type. Not bad for a young prime mover!

Bituminous Coal Research reports considerable progress in its efforts to develop a gas turbine for locomotive use, employing pulverized coal as a fuel. The coal is pumped into the combustor of the turbine as a fluid. In the unit presently under test, it is reported that one of the most difficult problems, that of wear and erosion, has apparently been satisfactorily overcome. The success of this type of turbine would undoubtedly lead to its use in many of the other fields where gas turbines are now in operation.

On the sea, the Liberty Ship *John Sergeant* is now propelled by a gas turbine, the world's first to be driven by this means exclusively. Its speed has been increased 50 per cent by the replacement. The machine is of the regenerative-cycle, two-shaft type.

Elsewhere in large ship propulsion, the combination of the free-piston engine (*Editor's note:* Watch this one come, too!) and the gas turbine is being researched. This is a combination just as promising in the improvement of efficiencies attainable as the combination of the gas- and steam-turbine cycles, and is equally as applicable to stationary as marine installations. As American technology improves, more will be heard of this.

In smaller hulls on water, and a variety of automotive uses, as well as small portable generators, gas turbines will take a place. As in any relatively new development, mass production must be assured by mass acceptance before small units will reach the market. Research is under way, however, which indicates that the necessary efficiency, reliability and low initial cost may be within reach in the near future.

In summary, the power engineer must regard the gas turbine not only as a source of mechanical power, electrical power and extra heat, but also as an instrument for the use of excess heat. Because these needs, in various combinations, are universal, you are sure to come to know the gas turbine very well within the next decade or two.

New Crane Lowers Boom on Maintenance Costs

NEW TYPE of self-propelled hydraulic crane has made big maintenance jobs a lot easier at the Duquesne Light Co's Brunot Island station at Pittsburgh, Penna.

Telescoping boom has capacity of five tons at a 10-ft radius, extends to lengths of 8 to 18 ft, and revolves through a full circle; boom angle can be adjusted from horizontal to 66 deg of elevation and is hydraulically controlled.

Purchased primarily to supplement the large 20-ton overhead crane in the powerhouse, the new unit has served as a puller, tugger, lifter, carrier, positioner, digger, and general jack-of-all-trades.

For more information, write the Editor, POWER ENGINEERING, Barrington, Ill.

Major overhaul costs at power station reduced 25 per cent by use of new crane

How's PVC Doing In Power Field?

Versatile new material—polyvinyl chloride—announced a few years ago, finds new power applications every day for pipe and fittings, tanks, ducts, fans and cooling towers, to cut maintenance

JUST A FEW YEARS ago, American industry got its first taste of a "miracle" plastic which had been in use, in Europe, for some years. This material, officially known as *polyvinyl chloride*, but called PVC by the manufacturers, took hold as very few products have in recent years. Since its characteristics are such that it has almost unlimited use in those applications where corrosion is the prime factor, it was only natural that power engineers would become intensely interested in it.

Like all new products, the original cost was high, and the manufacturing techniques had to be improved. With the coming of injection molding of fittings, and the extrusion of pipe, costs have come down radically in these two products. Also, the solvent-welding technique has drastically reduced the fabrication cost of piping systems.

One by one, other products which have traditionally been made of other materials, have appeared on the market — made of PVC. Besides the simple pipe fittings, flanges, valves, unions, expansion joints, check valves, and special fittings, have all been added to the line.

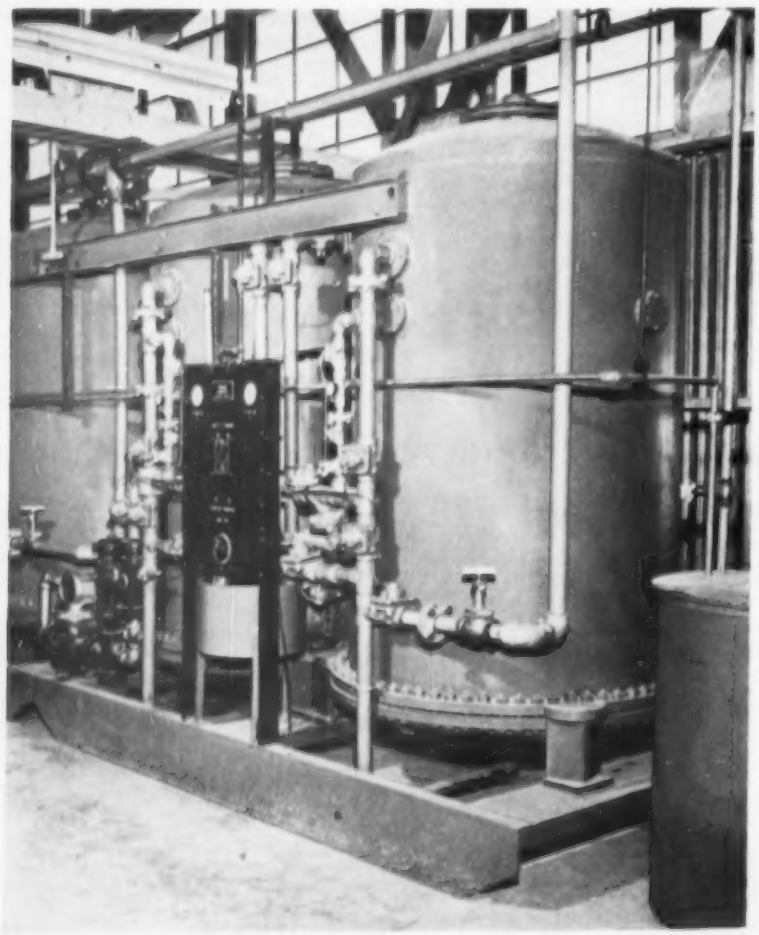


Fig. 1. Deionizer unit in G.E.'s Appliance Park, with portion of the PVC pipe and fittings used in the piping system

Next, the engineered-products field took to PVC as the ideal material with which to fabricate corrosion-resistant equipment. Simple tanks and exhaust hoods have been in service in an eastern plant for about eight years, and show no signs of deterioration. Combinations of sheets, shapes, pipe, fittings, and special devices — all of PVC — have limited the fabrication of corrosion-resistant products to basically two factors only: 1, temperature, and 2, the designer's imagination. All-PVC exhaust fans and cooling-towers (up to 25-ton capacity) are good examples.

An excellent application of a new material used in a conventional engineered product is the deionizer equipment shown in Fig. 1. This installation is in General Electric's Appliance Park, Louisville, Ky. The deionizer units were made by the Penfield Manufacturing Co, and the PVC valves and fittings were manufactured by Tube Turns Plastics, Inc. The assembly consists of four absorption towers, controls, and a PVC piping system that distributes the deionized water to the points of usage. Here, high purity water is involved rather than a corrosive acid; the use of PVC was indicated, and saved an estimated 50 per cent of the cost of Type 304 stainless steel originally planned for the job.

Practically every power engineer has one or more piping applications involving corrosive liquids; these can range all the way from simple salt water to concentrated acids or alkilis. A study of the chemical resistance table for PVC shows the material to be acceptable for most of the chemicals used in the more common power applications. In fact, in a list of some 162 chemicals, PVC is recommended for all except 24; and, most of those not recommended are of the "unusual" variety, like *cyclohexanone* and *tetrahydrofurane*. Boiler plants use such chemicals as hydrochloric and phosphoric acid, sodium chloride, sodium sulfite, and trisodium phosphate, as everyday production items. PVC is recommended for all of these.

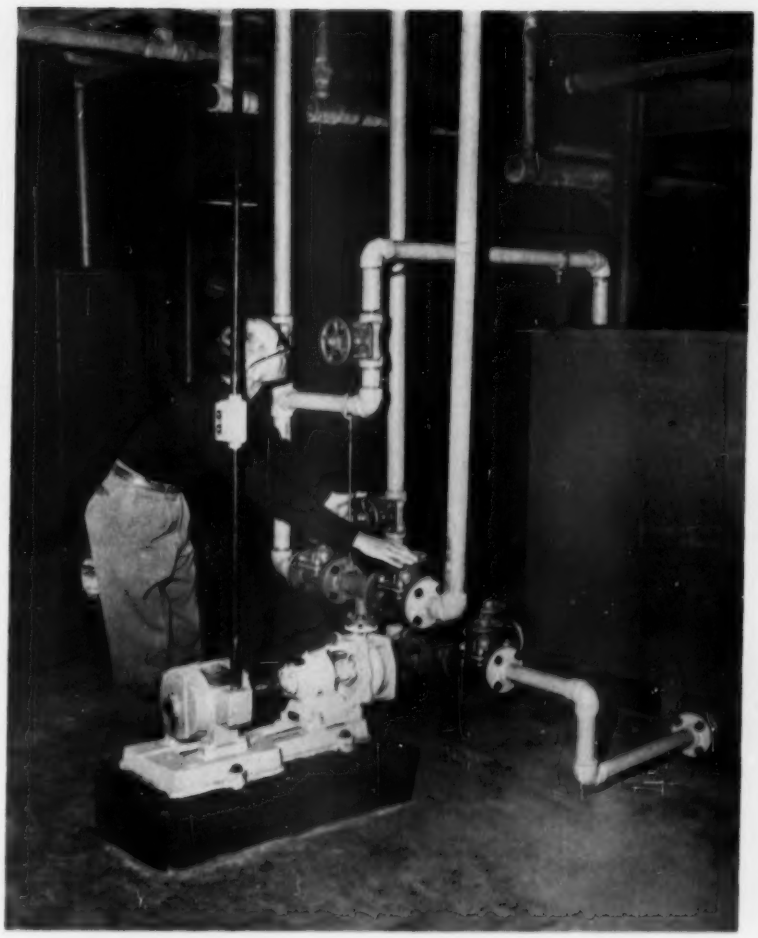


Fig. 2. PVC piping, valves and fittings are part of the chromic acid system in the plating department at Perfect Circle

Originally, PVC was joined by hot-air welding, or by threading, in the case of pipe and fittings. Later, solvent-welding was developed, so there are now three very satisfactory methods of fabrication. Many standard PVC products are on the market, from which to make complete assemblies: pipe, fittings, valves, tanks, ducts, cylinders, sheets, shapes, check-valves, fans, cooling towers, and many more. A good piping layout man can apply all of the conventional tricks learned in working with metal fabrication — to a PVC installation. In fact, this material is so versatile it can be worked more easily than metal. Repairs, if needed, can be made quickly and easily.

Some companies that work with chemicals exclusively have found by their own research that PVC solves practically all their corrosion problems; a few have begun long-range replacement programs of changing from metallic and other corrosion-resistant materials to PVC. Of those consulted, all report complete satisfaction. The Globe Chemical Co was one of the first such companies to start such a program.

Their new piping conveys mainly 77–96 per cent sulfuric acid, 61.4 per cent nitric, 37–38.5 per cent muriatic, 75–85 per cent phosphoric, and 99.5 per cent glacial acetic acid. Pipe is from 1¼ in. to 2 in., and carries pressures under 100 psi.

Before going to PVC, the company employed steel, wrought iron, stainless steel, aluminum, and lined pipe; failures occurred at 3- to 12-month intervals. After installing PVC pipe and injection-molded fittings, the owners reported these advantages: first cost was less than original job; there have been no failures; large piping inventory was eliminated; no product waste as the result of pipe failure; hazards of leakage caused by corrosion have been eliminated; no unscheduled shutdowns due to piping failures; no contamination of product due to scale in the piping system; no painting is required. This adds up to a pretty complete elimination of piping maintenance.

It is perhaps axiomatic to say that the best way to fight maintenance problems is to eliminate them, but many power engineers feel that PVC offers one happy solution to a great many of their problems. Unlike most plastic materials, it *does not undergo the phenomenon of aging.* This fact, alone, makes it worthy of consideration in almost every corrosive application where high temperature is not a factor.

An installation of PVC pipe, valves, and fittings, involving the handling of chromic acid solution, is shown in Fig. 2. This is only part of five separate piping systems, in the plant of the Perfect Circle Corporation, wherein different chemical solutions are handled, in connection with plating operations. Here, again, are valves and fittings of injection-molded PVC, which manufacturers claim are considerably stronger than those made by conventional compression-molding processes, on a strength-to-weight basis.

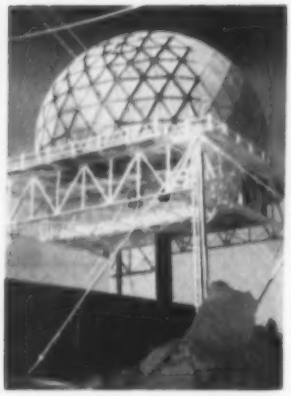
In the handling of acid or corrosive wastes, PVC offers an excellent and economical solution to most problems. The material is replacing some alloy cast iron and special ceramic pipe in numerous drain line installations. Its light weight, ease of handling, and cheaper total cost make PVC a tough challenger in any corrosive liquid drain line application. As no pressure is involved, a lighter weight pipe can be used for drain lines: this fact alone gives an immediate cost advantage. Thanks to solvent-welding techniques, the labor of assembling pipe and fittings is reduced to a minimum. In comparison with bell and spigot joints, the labor cost of making a PVC pipe and fitting joint is reduced about 90 per cent. Further, the joint materials cost in PVC pipe work is only 5 per cent that of bell and spigot joints. Labor costs are reduced, in every phase of the drain installation: delivery of materials to the point of assembly, cutting, joining, handling, and layout. Breakage is practically unknown with PVC pipe and fittings; this is not true with other materials used for corrosion-resistance.

Where pipe and fittings are exposed to view, PVC's attractive color and mirror finish make it very desirable. Manufacturers of engineered-products find PVC to have an aesthetic appeal which enhances the sales value of the equipment. In addition to the cheaper cost of joints, PVC offers *fewer* of them; its Schedule 40 pipe comes in lengths up to 20 feet, which cuts total cost and speeds installation.

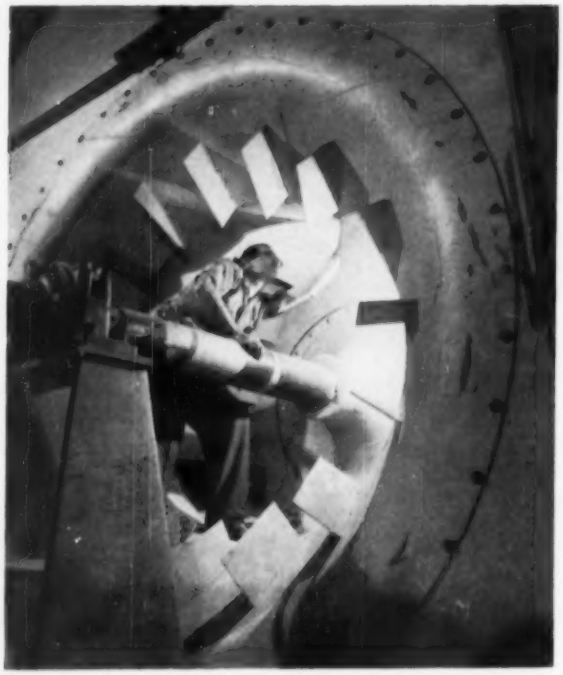
More and more power engineers will become conversant with PVC and its wide application in the power field. If you want more information on sources of this material, and on its applications to your problems, write the Editor, POWER ENGINEERING, or jot PVC on the return post card in this issue.

Largest Steam Station in U. S. is this 9-unit plant of the Tennessee Valley Authority near Kingston, Tenn. Total combined capability is 1,600,000 kw. At 80 per cent load factor, plant will burn more than 4,000,000 tons of coal a year. TVA power loads are growing

POWER ENGINEERING'S

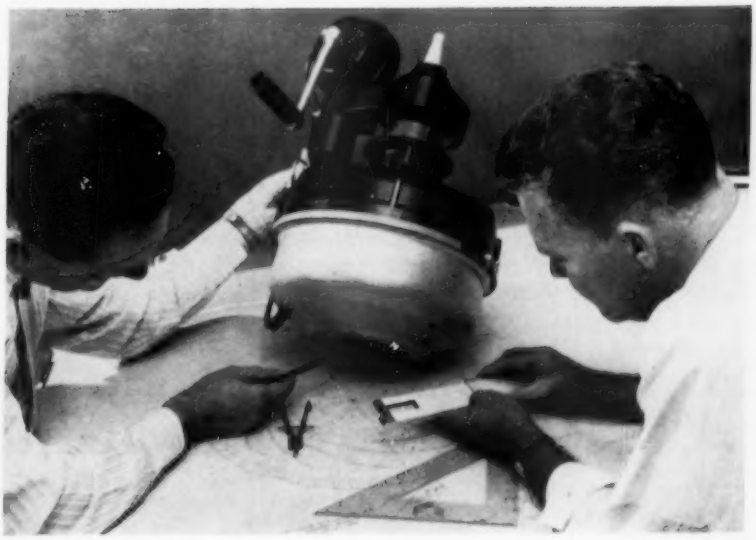


Cooling for the Arctic seems far-fetched. But mechanical cooling is a vital part of the 3000-mile warning radar line just completed across Arctic North America. Trane dry-type fluid coolers keep hot-operating tubes from failing in transmitters



Big Blow from 24 giant fans by Westinghouse ventilates the new third tube of New York City's Lincoln Tunnel. Combination of 11 blower and 13 exhaust fans can change air completely every minute and a half. Central control of system includes the spotting of carbon monoxide concentrations

Unusual Design by General Electric for Niagara Mohawk Power Corp eliminates need for series transformer by connecting load-tap-changing equipment directly in the high-voltage winding. Arcing contactors for changing taps under load are in these compartments on top of 120-kv bushings



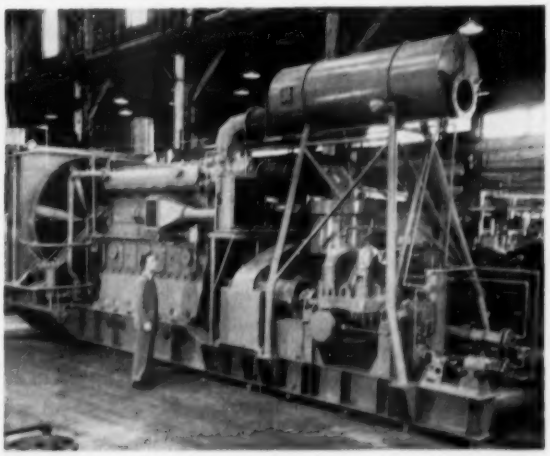
Smallest Gas Turbine aircraft engine yet to be built is only 20 in. high, weighs 50 lb, will power a one-man helicopter. Built by Solar Aircraft Co, tiny turbo-shaft engine produces 55 shaft hp plus 12 lb of jet thrust on a 100-F day. Rotor spins at 57,600 rpm

NEWS REEL

Boy With BB's, 35 tons of them, means serious business in the Westinghouse radiation lab. Steel walls ½-in. thick spaced 15 in. apart are filled with the steel bb's to shield a new "hot cell" used for examining reactor materials and radiation in industrial processes. Bb's equal 10 in. of steel

Pumps for Arab Oil are 4 portable 1000-hp, 600-rpm diesel power plants built by Enterprise Engine & Machinery Co for use in the rich new Wafra Field in the Middle East. Shipped from San Francisco to sheikdom of Kuwait, pumps will be operated in pipeline by American Independent Oil

Tilting Hull under heavy derrick shows the 467,000-lb weight of giant generator stator made by GE for Boston Edison Co's Mystic station in Everett, Mass. Unusual haul from Schenectady required 280-mile leg by water from New York City to Boston. Here the stator is loaded on ocean barge



Editor's Note:

This is the second of several articles on how to set up and begin operation of an industrial power plant.

If you wish to save these articles for reference, write the Editor for tear sheets.

Now's the time, if you're planning a new power plant, to start thinking of the maintenance records you'll need for efficient operation. Here's . . . . . .

How To Set Up Operating Records For Your New Industrial Power Plant

By PAUL N. GARAY

YOU PRESUME THAT you will get full efficiency in the operation of your new power plant. Will you? Will you really need certain repairs? Will you pay too much for any phase of your operations?

The answer to these questions may make a considerable difference to the profit or loss statement at the end of a year, and the way to proper control of plant costs starts with paper work. You should, therefore, maintain the following files:

1. Machinery index
2. Machinery history
3. Inventory of spares
4. Inventory of tools and equipment
5. A&I (alteration and improvement) program
6. R&M (repair and maintenance) program
7. Operating records and analyses
8. Cost records and budget breakdown
9. Maintenance tickler

Although it may seem to be a formidable task to set up and maintain such an amount of paperwork, it is really not difficult, if, once set up, entries are made "when occurring." Use these records, and ensure proper procedure to operate and maintain a smooth running, dependable plant at a minimum cost.

1. **Machinery index:** This may be kept in a ledger or as a card file. It should be set up for the new plant, and will prove invaluable for the life of the plant. The only work required on this record is the addition or deletion of items, and rare changes as made.

The machinery index is a complete record of each item or equipment in your plant, with name plate data, model, size, electrical information, power, capacity, usage, types and sizes of replaceable parts, and other pertinent, permanent information. It should be, in short, the source of any information you need about all mechanical details of the item. Serial numbers and applicable drawing numbers should be included.

Other information which you should be able to obtain from the machinery index, might be: How many tubes in the boiler? What size are they? What kind of soot blowers? What is the serial number of my pump turbine? Most of this information can be tabulated from the name plate data and the manufacturer's specifications.

The index should be set up under major headings, such as Boilers, Pumps, Blowers, etc. The large items are then further broken down to give an index this way:

Boilers—(All information pertinent to boiler)
Boiler Equipment: Water glasses
Soot blowers
Safety valves
Burners
Etc.
Pumps, main feed: Motor, pump

Tabulate all information in this manner until your file is complete.

2. **Machinery history:** This record should give a running account of inspections, repairs made, parts replaced, clearances existing, approximate operating hours, and dates. From this record, you can estimate repair schedules, repair or replacement costs, adequacy of maintenance, etc. This will give you the information needed for proper repair. Time put into repairs should be noted.

This record may be kept on cards, or in loose-leaf ledgers, and should be brought up to date on a "when done" basis. Usually the mechanic will make the rough work entry in the log, and the chief will transfer this rough entry to the formal history.

3. **Inventory of spares** is the record of what spare parts you have available. This record should be checked against projected future work, and material ordered as necessary in time for the work, or to keep adequate spares on hand.

4. **Inventory of tools and equipment** is a record of the tools, serial number (if any), manufacturer, date bought, dealer, and cost. These entries should never be deleted, but should be marked "replaced", "lost", or as otherwise applicable. It is a good idea to maintain a "loan out" page in the back of your operations ledger to keep track of tools or equipment taken outside the plant.

5. **Alteration and improvement** program is a record of past and future improvement programs, including descriptions and costs. A suggested method of keeping this record is by the use of forms similar to that shown in Fig. 3.

6. **Repair and maintenance** program is a counterpart of the A&I program, and uses a similar form. As the need for any work becomes evident, or is required by the maintenance schedule, these forms are filled out for all prospective jobs.

It will be noted that the form in Fig. 3, if properly filled out and used, is a complete plan and record of the work, past and present, occurring in your plant. These records should never be destroyed. There is some overlap between the R&M Program card and the machinery history card. However, the repair program can be used as a planning guide, while the machinery history is the actual notation of work done. The two records are complimentary.

The mechanics of your maintenance program will be discussed in another, forthcoming article. A visibly indexed card file, or other tickler system should be kept for scheduling

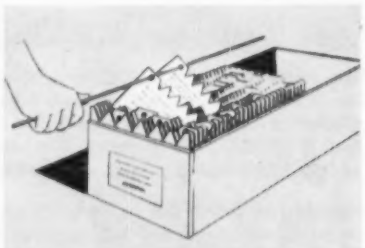


Fig. 1. Drawing shows operation of the tickler file. Rod lifts key cards only

routine inspections in connection with this program. You might find it convenient to use colored tabs on 4-by-5 index cards so placed that in the first week of a month all the green tabs will be removed, and the instructions thereon followed.

Another system utilizes 4 by 5 cards which are slotted or punched along the top half-inch; slots are placed at the intervals during which the card should *not* be removed. Punched holes are placed at the dates on which the cards should be removed. Then, by inserting a wire into the stack of cards, the wire intersects the holes in the proper cards, and these are lifted out. See Figs. 1 and 2.

7. **Operating records and analyses** form a legal and actual basis on which your operations can be judged. Shift-by-shift records should be kept and signed. The record can be made up as a form on one sheet, or it may be spread out to cover ledgers and/or form sheets. The following information should be covered:

(1) Narrative log, in which the occurrences during the shift are noted
(2) Repairs required and malfunctions
(3) Materials required
(4) Materials received
(5) Daily routine check-off list
(6) Daily lubrication check-off list
(7) Feedwater treatment and analysis results
(8) Boiler operating record:
Steam delivered, lb
Pressure and temperature
Fuel oil burned, gal.
Oil temperature
Feedwater used, gal., temperature
Air pressures (in. H_2O): windbox; firebox; last pass
Stack temperature, percent CO_2 in stack
Smoke density (max.) and duration in minutes
Water level for shift: lowest, highest
Feedwater pressure for shift, average
(9) Fuel oil received, gal. by sounding, by invoice, temperature at which received
(10) Tanks in use; Fuel in tanks (gal.)
(11) Condensate returned (gal.)
(12) Fresh water used (gal.)
(13) Machinery operating and approximate hours
(14) Regeneration of water softener (gal.); salt added (lb)
(15) Electrical power delivered (kwhr); average power factor; volts; amperes
(16) Electrical power used (kwhr)
(17) Steam or power delivered to various services
(18) Btu/lb steam, or Btu/kwh. In case where steam is delivered, electricity used by plant should be considered as Btu input, and added to heat value of fuel. When electricity is the product, subtract plant usage from electrical output. This will give a picture of the day-to-day plant efficiency.

8. **Budget and cost records** should be set up for your plant. A budget should contain estimates of all your prospective expenditures for the year, including fuel, repairs, spare parts, wages, insurance, tools, improvements, special help or services, chemicals, materials used, sick leave, and any expenditures you may foresee.

Assign a percentage of your total budget to each of these items, and then further refine your estimates by dividing up the expenditures into four quarters. You will then have a check every three months on how your actual costs compare with estimated costs. Cost analysis can be further aided by assigning an account number to each category of expense.

These, then, are the records and reports which should be maintained. Depending on the size of your installation, some parallel records can be doubled up. In the simplest case, machinery index, machinery history, A&I and R&M files can be combined into one record. It is suggested, however, that in starting up a new plant, these records be organized properly right from the start.

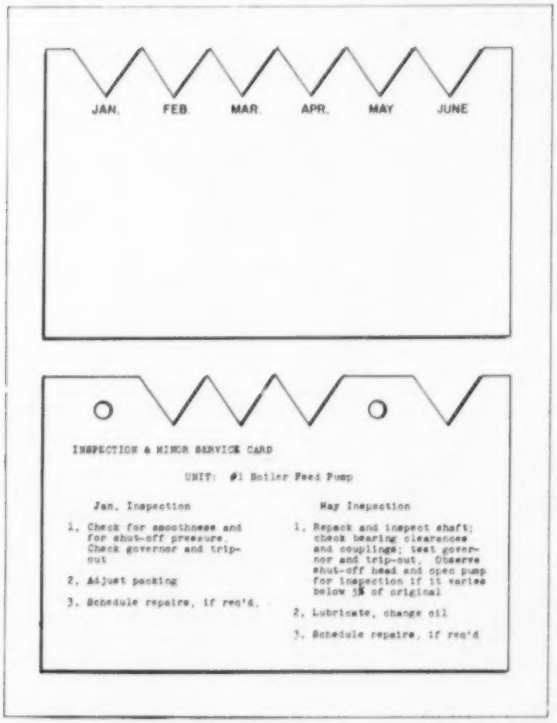

JAN.
FEB.
MAR.
APR.
MAY
JUNE
INSPECTION & MINOR SERVICE CARD
UNIT: #1 Boiler Feed Pump
Jan. Inspection
1. Check for smoothness and for shut-off pressure. Check governor and trip-out
2. Adjust packing
3. Schedule repairs, if req'd.
May Inspection
1. Repack and inspect shaft; check bearing clearances and couplings; test governor and trip-out. Observe shut-off head and open pump for inspection if it varies below 5% of original
2. Lubricate, change oil
3. Schedule repairs, if req'd

Fig. 2. Sample tickler cards: upper card is first in file, marked by dates, lower card keyed to maintenance interval

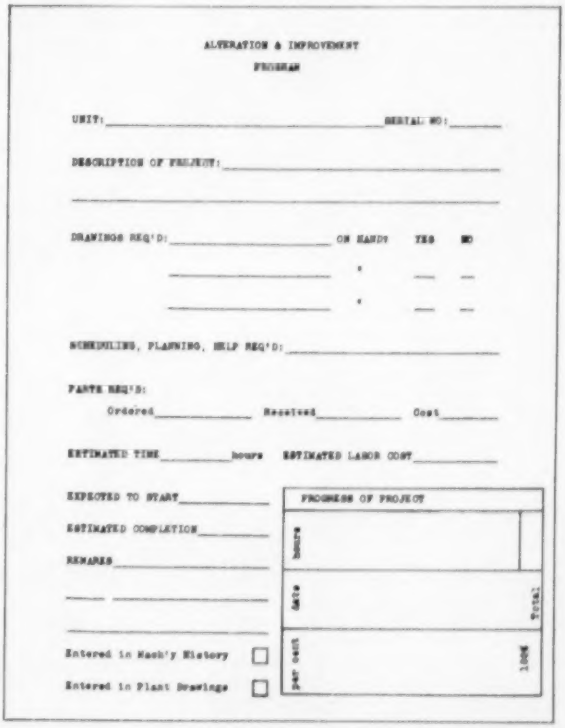


Fig. 3. Alteration and Improvement program schedule; same form can be used for Repair and Maintenance program

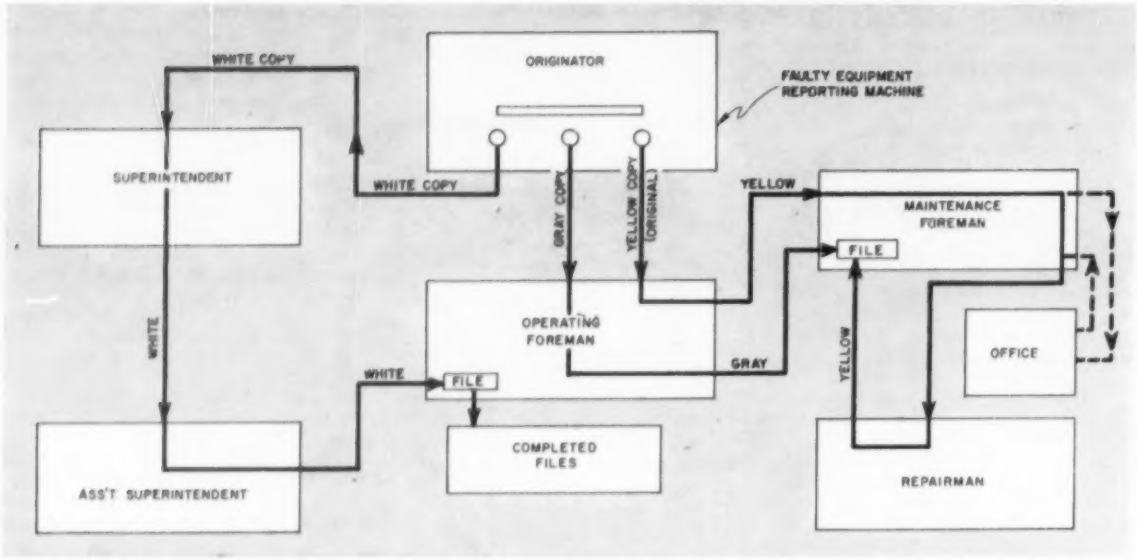


Fig. 1. Smooth and easy flow system for copies of reports is essential part of successful handling of faulty equipment reporting and repair. This diagram shows how report copies are circulated at Valley Steam Plant. Copies are made automatically

Good Way to Report Faulty Equipment

Here's how they have systematized written reporting on equipment faults detected during shifts at the big new Valley Steam Plant near Los Angeles. Keeping paper work at minimum is a big point

By R. C. ALEXANDER*

PROBLEM commonly experienced by large industrial operations such as steam-electric generating stations is the method of handling faulty equipment report and repair. The difficulty is created by 24-hour operation, 365 days per year, where the P.M. and A.M. shifts do not have direct contact with their maintenance and supervisory sections. These latter groups normally operate only during regular work hours, and therefore require unusually complete, written, accurate reports of equipment faults detected during all other working shifts.

This problem was early recognized at the Valley Steam Plant of the Department of Water and Power of the City of Los Angeles, and the approach to its solution is described herein. It was also recognized that the operators and workmen must be provided the physical means by which they would have a minimum of paper work to do in their reporting, thus encouraging a full and accurate write-up of "faulties."

A Faulty Equipment Report sheet was designed that enabled detailed reporting of faulty equipment with the least possible writing (Fig. 2). Unit number, shift, and type of fault require only a checkmark. The form was also designed to be readily adaptable to a standard electric-driven manifolding machine, which automatically produces two carbon copies. The original and first carbon copy are ejected merely by operating a push-button and the second carbon copy of the report is retained in the machine.

At Valley Steam Plant there are four steam-electric generating units controlled by wires from two control rooms. Each of these rooms is furnished with an electrically operated manifolding faulty equipment report machine. Any employee may make a report on either machine regarding faulty equipment observed.

Distribution of the three copies produced in this reporting is shown graphically on the flow diagram of Fig. 1 and is as follows:

The original (yellow) and first carbon (gray) reports are immediately transmitted to the operating foreman so that he may become aware of the conditions reported. Then, each morning at 6:30 A.M., these copies are forwarded by him to the maintenance foreman. This foreman, after examination of the reports, then issues the yellow copy to the repair craft involved.

This same copy automatically serves as a work order requiring no additional orders or paper work. The preprinted serial number shown on the lower right hand corner of the form also serves as the work order number.

This report serial number is also the office record against which authorization for the labor and material charges are made. This same number also provides the workmen a charge number against which materials and tools may be withdrawn from the warehouse and tool room.

Thus, without additional authorization or paper work, the report serial number effectually ties in all phases from report to authorization, through repair and so down to the final record.

The gray copy is retained by the maintenance foreman to function as

*Supt, Valley Steam Plant, Department of Water and Power, City of Los Angeles

DEPARTMENT OF
WATER AND POWER
VALLEY STEAM PLANT
FAULTY EQUIPMENT REPORT

UNIT 1 2 3 4 ALL	ELECTRICAL ☐
DATE 19 TIME M	MECHANICAL ☐
SHIFT A D P	INSTRUMENT ☐
REPORTED BY:	FOREMAN

ONE ITEM PER SHEET—DESCRIBE IN FULL
DESCRIPTION:

ASSIGNED TO REPAIR COMPLETED 19	NOTE: FOR INSTRUMENT FAULTIES, SHOW UNIT LOAD, TIME, ALL OPERATING CONDITIONS CONCERNED
ENTER DETAILED DESCRIPTION OF WORK PERFORMED ON REVERSE SIDE.	REPORT NUMBER 310

Fig. 2. Valley Steam's faulty equipment report form takes minimum of writing. Check marks designate unit numbers, shift and type of fault. Original copy is yellow, 2nd copy is white, 3rd is gray

Fig. 3. The two control rooms at the Valley Steam Plant are each furnished with electric manifolding faulty equipment report machine. Any employee may use these

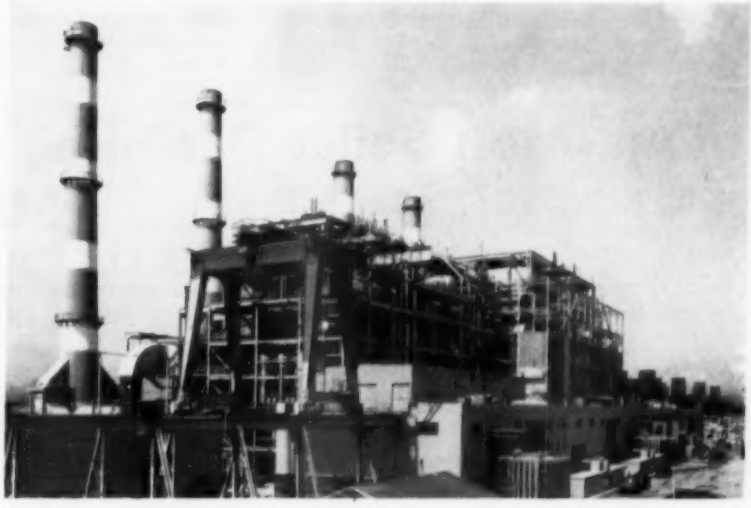


Fig. 4. An outdoor installation, Valley Steam Plant towers the equivalent of 13 floors in the air, is one of the largest inland steam electric generating plants

his record of work in progress and for work orders issued.

At this same time the white copy is directed to the superintendent's office for review and for such extraordinary action or investigation as may be required.

After review by the superintendent, assistant superintendent examines this same copy and transmits it for open filing in the operating foreman's office, insuring that these foremen are made aware of the faulty equipment previously reported and under repair. Unnecessary duplication of report is thereby eliminated.

The maintenance foreman utilizes his gray copy to keep abreast of the work in progress. If, however, this work cannot proceed under operating conditions, the yellow copy is stamped by him, Hold for Overhaul or Shutdown.

These stamped first copies are then transmitted to the general office where they are held for such time as they may be included in the listing of work to be done in the first shutdown or overhaul. At that time the copies are reactivated by transmitting to the maintenance foreman who then reissues them during shutdown or overhaul time for the required attention.

After completion of the repairs, the workmen involved return the yellow copy to the maintenance foreman who, by report number, discards his gray copy and retains the yellow one in his completed files. Workmen are encouraged to enter detailed description of the fault and the work required to correct same on the back of their copy. This, then, provides an excellent history of the fault and the necessary steps to its correction without additional paper work and in the terminology of the craft.

At this time, the maintenance foreman also removes the active white copy from the open file of the operating foreman, keeping these files clear of inactive reports. This copy could be returned to the superintendent or assistant, if desired, to indicate completion of the work; however, it is not done at the Valley Steam Plant.

Following an extended period of operation after installation of the foregoing system, experience has shown it to be very successful. The psychology of the system, particularly due to the electric push-button ejection of the machine reports and because of the form of report, has encouraged excellent, detailed reports of the faults, their locations, and effects.

With modification, this system appears to be readily adaptable to conditions within many other industrial operations.

At the Valley Steam Plant we feel that the initial cost of the machines and printing of the forms has been many times repaid by the saving of field labor, office paper work, duplication, and prompt repair of faulty equipment.

Photos courtesy E. I. du Pont de Nemours & Co.

Fig. 1. After cleaning 500-hp boiler with sulfamic acid, only 3½ lb of solid material remained from estimated 150 lb of scale originally present. This too would have been dissolved if circumstances had permitted standard practice

One-Man Boiler Descaling at Norda With SULFAMIC ACID

Relative newcomer among boiler cleaners and descalers, easy-to-handle sulfamic acid has proved safe, effective for tough jobs

CLEANING AND descaling boilers, heat exchangers, steam cylinders, and similar equipment is generally a troublesome, time-consuming, and sometimes dangerous job.

You can now avoid much of this trouble — and save a good deal of time — by utilizing one of the relatively new sulfamic acid cleaning compounds now available. An example of the effectiveness of these compounds under certain conditions is given in this case history of a boiler descaling job performed by one man — safely, and with a minimum of fuss and bother.

Physically, sulfamic acid is a white non-hygroscopic, non-volatile, solid inorganic acid, available either in crystalline or granular form. When dissolved in water, it forms highly ionized solutions which approach the strength of sulfuric, muriatic or nitric acids. Yet, solutions of sulfamic acid are much less corrosive to all metals than these mineral acids, and are easily inhibited to prevent attack of the metal being cleaned.

First prepared in a chemist's laboratory more than one hundred years ago, the acid remained a curiosity until 1940 when the Du Pont company developed the first practical method of manufacturing it. The last few years have seen a rapid acceptance of sulfamic as both an industrial and household cleaner.

Effectiveness Demonstrated

The effectiveness, safety and ease of handling of these relatively new cleaners was demonstrated recently when one man cleaned a heavily scaled 500-hp Titusville horizontal Scotch Marine boiler (3200-gal. capacity) at the Norda Essential Oil Company, Boonton, N. J. The only equipment he used was a pair of gloves, a welder's helmet (in place of goggles), a stirring paddle, and a portable ½-hp pump. Total working time was seven hours, excluding 48 hours of just plain waiting.

When Norda, a leader in the perfume oil industry, decided to switch from oil to gas firing, each of their four boiler units was examined carefully. Three of the four appeared in excellent condition, but the fourth, built in 1953 and bought second-hand in 1955, was heavily scaled. An investigation showed that faulty operation of the blow-down control had permitted a rapid build-up of calcium carbonate and iron oxide deposits, seriously impairing the boiler's efficiency. It was decided to clean the unit prior to making the change-over.

Unfortunately, time was short. Taken off the line on a Friday afternoon, the boiler was needed for making process steam on the following Monday. There was not enough time to bring in a professional boiler cleaning firm, with the necessary special equipment and trained crews, and still get the job done on time.

Norda turned for advice to their water treatment consultants, E. F. Drew and Company, whose research and technical laboratories are in Boonton. Recognizing the urgency of the situation, Drew engineers tested the scale and found it to be readily attacked by their proprietary sulfamic-based cleaner. Next, they worked out a procedure that could be completed during the weekend, would require no special apparatus, and could be carried out safely by inexperienced personnel. The fact that sulfamic acid can be handled easily and safely with reasonable and simple precautions,

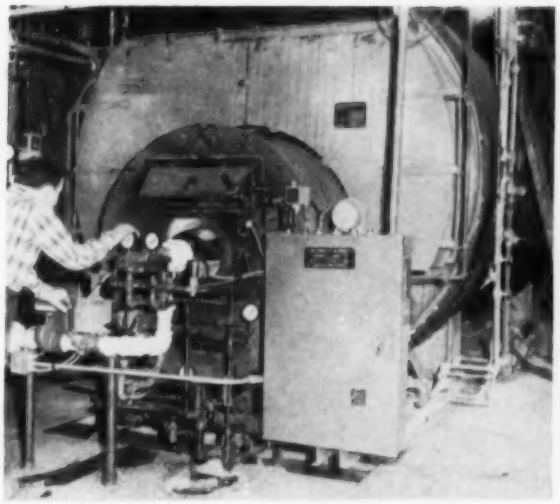


Fig. 2. Although heavily fouled, this boiler was completely descaled by only one man using a sulfamic acid based cleaner

Fig. 3. Unlike many other types of acid cleaners, sulfamic acid's dry crystals give off no fumes, present no problems

had much to do with Norda's decision to attempt the task.

To do the actual cleaning job, Norda called upon the local firm of R. F. Sutton and Son who had designed and were to install the new gas-firing controls. Primarily control specialists, the Suttons had only one previous descaling experience, which had proved quite unpleasant. Using hydrochloric acid, they encountered excessive foaming and other problems. In addition, the liquid acid had been difficult to handle, had attacked the boiler metal and had ruined several articles of clothing. They were therefore understandably reluctant to try a second cleaning job, but one of Drew's research engineers encouraged them to make the attempt.

Job Done Over Weekend

At the close of work on Friday the boiler was drained and refilled with feedwater at approximately 210 F. As the boiler was filling, 400 lb of the dry cleaner was mixed with tap water and pumped through a manhole on top of the unit. No damage to the pump's cast iron parts was noted, even though the acid solution passing through was extremely concentrated. The resulting solution in the boiler was approximately 2 per cent acid. Mixing was done in two batches in an ordinary 55-gal. drum.

Four hours were needed to complete the draining and filling process, while only 15 minutes were required to mix the solution and pump it into the boiler. To take care of the carbon dioxide formed by the reaction of the acid and the carbonate scale, the safety valve — vented through the ceiling — was tied open.

Normally the job would have taken eight hours or less. However, since the whole weekend was available, another plan was decided upon. Because of its low corrosive characteristic, the sulfamic acid solution was allowed to remain unattended in the boiler for 48 hours without being circulated. The boiler was not fired during the descaling, and no further activity took place until Sunday evening when the solution was drained.

It was noted that the temperature of the solution had dropped to 98 F, and the color of the solution indicated residual acidity in the neighborhood of 0.5 of 1 per cent — just enough to be partially effective. Based on this decrease in acidity, it was calculated that the amount of scale removed and dissolved was about 150 lb. Use of the solution's color to indicate degree of acidity is a built-in property of Drew's cleaner and is not inherent in sulfamic acid itself. A detergent flush removed the remaining small amount of loose sludge, making the unit ready for immediate service.

"I really don't know what I expected to see," said Sutton, "but when I looked in and saw that every bit of scale had been removed with no damage to the metal itself, I could hardly believe it. Most of the scale had been dissolved, and only three and a half pounds of residual solid material remained, much of it in large chunks. Considering the trouble I had with hydrochloric, this was child's play. It's hard to figure how something so safe and easy to handle can do such a good cleaning job."

Increased efficiency resulting from the cleaning was apparent immediately. Prior to descaling it had taken 26 minutes to bring the boiler water to a boil; now the same operation takes only 18 minutes. According to a Norda spokesman, time and fuel savings will completely pay for the entire cost of descaling within a very short time.

Fig. 4. Portable pump was only equipment needed—to pump solution to boiler

Table I. Cost data on construction of power plant, Richmond State Hospital

ARCHITECTS & ENGINEERS	
Fleck, Quebe and Reid Assoc Indianapolis, Ind.	$ 62,261.11
GENERAL CONTRACTOR	
F. A. Wilhelm Constr. Co, Inc Indianapolis, Ind.	397,483.27
MECHANICAL CONTRACTORS	
Hipskind Heating & Plumbing Co Fort Wayne, Ind.	361,015.00
STEAM GENERATING UNITS	
R. A. Hackney Indianapolis, Ind.	290,700.00
STACK	
J. M. Cutshall & Son Brazil, Ind.	33,487.00
MISCELLANEOUS	2,884.50
TOTAL	$1,102,830.88

Design of the new steam plant for the Richmond, Indiana, State Hospital incorporates unusual pentagonal shape. Also unusual —weekly confabs between contractors keep job rolling along smoothly with change orders less than 1 per cent of contract

Fig. 1. Trades and State officials meet for weekly work-progress discussion under breezy direction of Bob Reid of Fleck, Quebe & Reid, architect-engineers. This way, costly errors could be forestalled, work speeded, friction kept at minimum

Coordination Meetings of Subs

UNUSUAL SOLUTIONS to some common power plant design and construction problems have been demonstrated in the planning and erection of a new steam power plant at the Richmond State Hospital in Richmond, Indiana. Now nearing completion, both the plant and the manner of its building are of interest to power engineers who are, or may be, faced with similar problems.

In planning the plant, first consideration was space. Immediate requirements called for three 31,000-lb-per-hr boilers, but it was necessary to provide for the later addition of two similar units to meet loads expected in 1980. Space available was limited, and a conventional building to house five boilers would have resulted in an inconvenient, overcrowded structure.

Fleck, Quebe and Reid of Indianapolis, architects and engineers, and F. B. Morse of Purdue University, engineering consultant, resolved this dilemma by designing a pentagonal building in which the five boilers will fit comfortably within 7000 sq ft instead of the 10,000 to 12,000 sq ft ordinarily required.

All boilers face radially inward (see Fig. 2), and the power plant operator at his station in the center can easily observe each boiler and its panel without leaving his central location. In addition, auxiliary equipment installed in the spacious corners behind the boilers is readily accessible. These factors simplify one-man operation, an important item in state-owned facilities with limited operating budgets.

Also budget-minded is hospital management. Determined that the state get most plant value for every dollar allocated by the state for the project, Fleck, Quebe and Reid proposed that they institute a regular series of coördination meetings to be attended by all contractors and subcontractors during course of the construction. Hospital management readily agreed, and meetings were held periodically to iron out difficulties, contentions or disputes that arose in the progress of the work. In the early stages of construction, meetings were called every two weeks; in later stages, monthly meetings were sufficient to keep the job going smoothly.

Success of these meetings has been outstanding, says William Brenizer, Business Administrator for the hospital. "As a direct result of the coördination meetings," stated Brenizer, "we have held engineering change orders to less than 1 per cent of the contract."

Robert Reid, president of Fleck, Quebe and Reid, is equally enthusiastic. Reid pointed out that the regular meetings tended to bring impending difficulties out into the open before they became actual trouble, and mutual discussion of the situation by the trades involved forestalled later conflicts of interest. Another important benefit, he added, was the early elimination of subcontractors unable or unwilling to fulfill the terms of their contracts to the letter; minutes of previous meetings provided a valuable record of who promised what, and when.

Total effect of the coördination meetings has been to assure that the hospital got full value for money expended — every dollar has gone into sound construction, reliable supervision, and first-class equipment (see Table I).

Present equipment in the plant includes three Vogt 2-drum water tube boilers operating at 125 psi with a normal capacity of 31,000 lb per hr and a 2-hr peak capacity of 35,000 lb per hr.

Laclede chain grate stokers are driven by small single-stage mechanical drive turbines operating at 1800 rpm with inlet steam at 125 psi, exhaust, 6 psi. Over-fire air fans are driven by similar turbines operating at 3333 rpm.

Other equipment powered by mechanical drive turbines is the forced draft fan (1478 rpm) and the three feedwater pumps (3500 rpm). Two of these pumps are rated at 32 hp and one at 15 hp. Either of the larger pumps has sufficient capacity to handle the ultimate of five boilers.

Although 10 mechanical drive turbines are installed to drive auxiliary equipment, only 3 sizes are used — a factor that greatly reduces repair

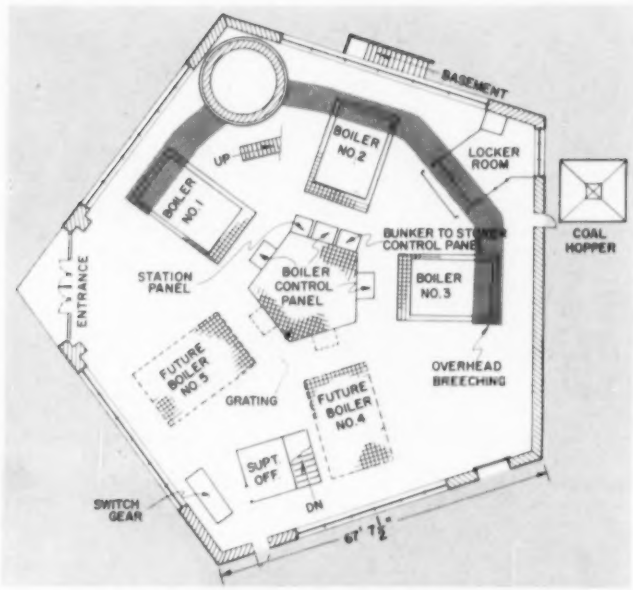


Fig. 2. Unusual pentagonal shape was selected because it took most economical advantage of square footage available for plant. From central point, one man can control full eventual set of five boilers

Fig. 3. Exterior of plant. Entrance at extreme left. Barely visible is aluminum-sided penthouse for coal handling (see Fig. 6, next page)

Build a Power House Pentagon

parts inventory carried in the plant.

Coal is brought into the plant from a track hopper; from the basement hopper, it is conveyed to a Redler elevator that lifts the coal to the centrally-located overhead bunker (Fig. 6). This Stephens-Adamson equipment has a capacity of 25 tons per hr.

The cylindrical bunker has a total capacity of 125 tons. Beaumont-Birch under-bunker coal handling system is unique in that a straight-through gravity flow is provided from the bunker to the three present coal scales, and thence to the stokers — almost eliminating the possibility of coal stoppage due to mechanical failure. Instant by-pass of coal scales is possible, and provision has been made for the two future boilers.

Bottom of the bunker is fitted with a high-temperature alarm system, a drip- and sift-proof gate, and an emergency chute to by-pass bunker coal into trucks.

Boiler controls and instrumentation are pneumatically operated. One 25-hp and one 7½-hp Joy compressor furnish air for the system. Water treatment for the expected 30 per cent makeup will be a zeolite system by Cochrane Corp.

Tied in with the ash handling system is the vacuum cleaning piping to 23 outlets in various locations in the power plant building. A 15-hp U. S. Machine Corp vacuum pump is located in the basement of the power plant adjacent to the ash system exhauster and discharges sweepings to that system for handling and collection.

Fig. 4. The three water-tube boilers have 31,000 lb/hr continuous capacity, 125 psi operating pressure. Mechanical drive turbines are used for over-fire air (r), stoker drive (left)

Fig. 5. Auxiliaries are installed in basement level. Here's a view of coal conveyor connecting track hopper with coal elevator which rises to top of bunker (turn the page for plan)

Throughout the planning and construction of the plant, Sheldon Moore, chief power engineer, has taken an active part in all meetings and discussions. This has had two beneficial results: First, his operating experience provided valuable practical know-how to the engineers in planning layout and location of equipment; second, his participation in all phases of the work gives him a beforehand knowledge of every item in the plant — operating or structural.

Nature of the coördination meetings was such that Moore was free to raise questions, request changes, or debate the practicality of any given proposal. Outcome of this situation is that the plant operators will take over a plant tailored to their needs and experience.

As Moore put it, one of the most significant operating problems he will have is the type of personnel available to him; for that reason, it was important that this criterion be kept uppermost in planning the design of the plant. Moore was always on hand to see that that principle guided decisions on the utility of proposals suggested by the builders.

In spite of all these precautions, however, a few imperfections have come to light as the plant takes final form. One of these was recognized when piping was installed, and is due to the shape of the building.

Since the building is five-sided, pipe lines around the perimeter of the basement cannot corner with either 90- or 45-deg elbows. This problem could have been solved with two 90's, one above the other, but headroom in the basement is insufficient to permit general adoption of this plan. Special 72-deg elbows had to be procured, a headache for the pipefitters. Nevertheless, the Richmond State Hospital power plant is one of the most successfully planned and built institutional power plants your editors have seen in some time.

Table II. Principal equipment installed in new power plant, Richmond Hospital

Boilers	Henry Vogt Machine Co
Stokers	Laclede Stoker Co
Forced Draft Fans	Fly Ash Arrestor Corp
Combustion Controls	Copes-Vulcan Div Blaw-Knox Co
Boiler Feedwater Regulators	
BF Pump Excess Pressure Regulators	
Soot Blowers	Diamond Power Specialty Co
Boiler Feed Pumps	Dean-Hill Pump Co
Steam Turbine Drives	
Coal Handling Equipment (track hopper to bunker)	Stephens-Adamson Co
Coal Handling Equipment (bunker to stoker)	Beaumont-Birch Co
Deaerating FW Heater	Stickle Steam Specialty Co
Hot Water Storage Heater	Patterson-Kelley
Over-Fire Air Fans	Clarage Mfg Co
Ash Handling Equipment	United Conveyor Co
Zeolite Water Softener	Cochrane Corp
Boiler Instrumentation	Taylor Instrument Cos
Boiler Water Treatment	National Aluminate Co

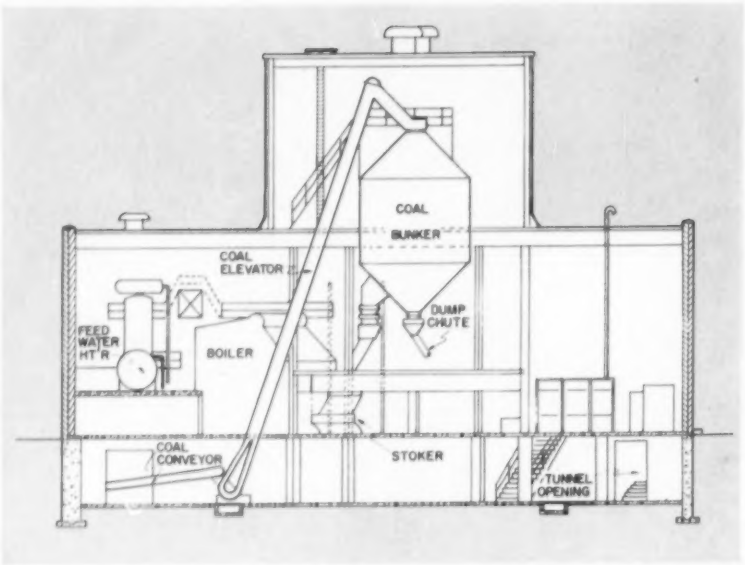


Fig. 6. Elevation showing coal-handling scheme. System provides a straight-through gravity flow from bunker to the three present coal scales and from scales to stokers, practically eliminating chance of coal stoppage from mechanical failure

Fig. 7. View toward boiler No. 2 from point near center of plant. Bunker looms over all. Extreme bottom of bunker is fitted with high coal temperature alarm system, a drip- and sift-proof gate, and an emergency chute which leads to trucks

Running-In Auxiliary Equipment At Power Plant Start-Up

This discussion focuses on the boiler fans, air compressors and miscellaneous pumps. Condensate pumps, b-f pumps and circulating water pumps were covered earlier in this popular series of articles

By J. H. HUNNICUTT*

WHILE CONDITIONS always vary in some respects with various types of equipment, there are three cardinal rules common to all rotating machinery which must be followed if future trouble-free operation is to be the result:

1. Proper alignment between the driver and the driven component must be assured.

2. All bearings must be thoroughly flushed and clean, and correct lubricant in the proper quantity must be provided.

3. Where size and weight of equipment permit, all new equipment must be rotated by hand prior to starting, to assure that the installation is free of obstructions or rubs.

At an early point in the preliminary operations schedule, the responsibility of flushing and lubricating of all new equipment bearings should be definitely and clearly established. Wherever labor rules permit, this function should more logically be taken over by the permanent plant personnel who will subsequently be responsible for maintenance of the equipment; but whoever does the work, a rigid routine should be set up and responsibility clearly established.

Before any electric motors are "bumped" for rotation check, the oil in all bearings of both the driver and the driven equipment should be drained and flushed with the same lubricant that will be provided for operation. An obvious exception is the lubricated-for-life type of electric motor, but in all other cases the importance of proper flushing and cleaning cannot be too strongly emphasized. This is particularly true in the case of outdoor installations and wherever equipment has been stored for any appreciable length of time.

Next Steps

After flushing, all bearings and journal boxes should be filled to the manufacturer's indicated level with the lubricant recommended for that particular piece of equipment. A card should then be affixed both to the driver and the driven equipment, showing the date the bearings were flushed and the journal boxes filled with lubricant, the type of lubricant used and the signature of the person who actually did the work.

After rotating equipment has been set and aligned by the construction forces, the couplings between the driver and the driven component should be broken and left loose until just prior to initial operation. This will save time later in determining correct directional rotation after the electrical cables have been pulled in and connected, and alignment should always be re-checked just before starting any machinery for the first time. Whether the two coupling halves are to be aligned in the "zero" position, or whether the driver half should be set a few thousandths higher or lower than the equipment half of the coupling, will depend on the temperatures attained by the equipment during operation, and manufacturer's recommendations should always be carefully followed in this regard.

Finally, unless size and weight of the equipment renders it physically impossible to do so, all new installations should be rotated by hand before starting. Rotation should be smooth and free of rubs and knocks.

Forced and Induced Draft Fans

Induced draft fan should always be started first, with the inlet damper in the minimum-open position. This is to prevent unduly pressurizing the boiler casing, which would be the case if a forced draft fan were started first. Actually, if the combustion controls have reached a point nearing completion, the purge interlock system will have made it impossible to start a forced draft fan unless the induced draft fan is already in operation.

Immediately check all bearings to see that the oil rings are rotating on the shaft and delivering oil up into the bearings. Any significant vibration is ample reason for stopping the unit immediately until the reason for the vibration is determined and corrected. As a general rule, if coupling alignment has been checked and is known to be correct, excessive vibration can be traced to one of two causes: 1. the positioning bolts holding the top halves of the bearings in place may have worked loose and must be tightened; 2. something may have occurred during shipment or erection that has brought about a condition of imbalance in the fan rotor. In this event, the problem immediately becomes one for a factory representative.

After the induced draft fan has been started and proved to be operating properly, start the forced draft fan with its inlet vanes in the minimum-open position. Immediately check the bearings to see that there is no significant vibration. Run in both fans for a minimum of six hours, maintaining a close watch on bearings to see that no overheating occurs. During this period, the draft controls should be operated throughout their operational range, care being exercised to prevent any undue positive air pressure within the boiler casing.

Air Compressors

As a rule, and particularly in the case of carbon-ring compressors, new units should be allowed to idle in a no-load operation until the rings have had an opportunity to wear in. Check the flow of cooling water to the compressor jacket and after-cooler. *Always* start any new compressor with its valves in the unload position.

After a two-hour period to allow new rings to wear in, allow the machine to load and build up pressure in its receiver. Check closely for valve knocks and observe that the controls unload the compressor as the desired upper pressure limit is reached. A six-hour run-in period without the development of complications will assure that the installation is ready for service. It is good practice, where carbon-ring compressors are involved, to drain the crank case after this run-in period and replace the lubricant with clean oil.

Miscellaneous Pumps

All pumps in systems containing new piping should be fitted with suction strainers prior to their initial operation. With the exception of the condensate and boiler feed pumps, flat wire strainers inserted between the suction flanges will normally suffice. The competent operator will assume that the system is dirty and will inspect these strainers at frequent intervals until a complete and continued absence of debris indicates that the system is clean, after which the strainers may be removed.

Packing glands of pumps in water service should be sufficiently loose to permit a slight leakage when the pumps are first started and this leakage should be permitted to continue until the packing has had an opportunity to wear in, after which the glands may be gradually and evenly tightened and the pump considered ready for service.

* Formerly Project Supt., The Kuljian Corp., now with United Engineers & Constructors, Inc.

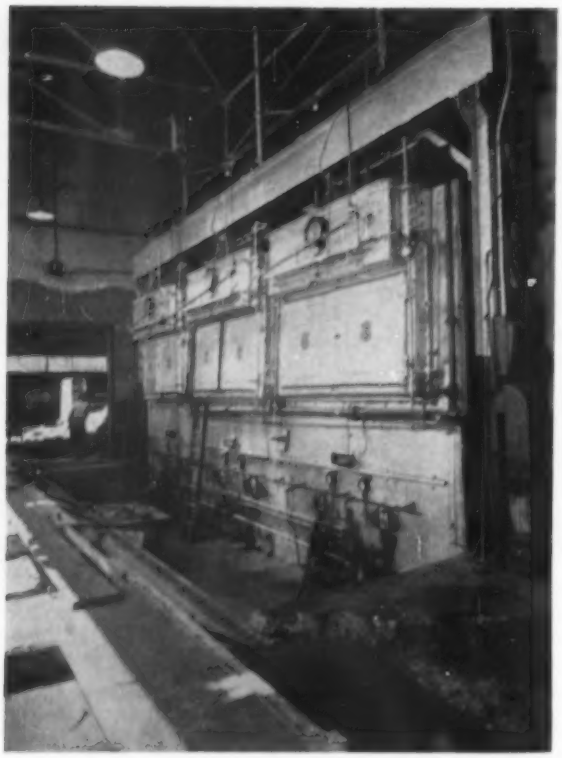


Fig. 1. Original boiler installation in Plant E. View taken after start of construction in the modernization program

MODERNIZING COST PLANT E—1952–53

Boilers—Three class VF water tube boilers 180 lb design pressure, maximum rating 16,000 lb steam per hour, 2186 sq ft boiler heating surface, 299 sq ft water wall surface, superheater for 50 F superheat, erected complete including:	Henry Vogt Machine Co	$ 87,131
Oil burners	Peabody Engineering Corp	
Soot blowers	Diamond Power Specialty Co	
Forced draft fans	L. J. Wing Mfg Co	
Flame failure devices	Peabody Engineering Corp	1,116
Stack and flue—60″ dia x 145 ft high, 5/16″ plate, guyed, and flue ¼ plate, delivered and erected	Norwalk Tank Co	14,099
Piping, including new high and low pressure steam lines to factory, relo-	Mitchell & Bailey, Inc	31,523

What It Costs to

By H. D. FISHER *

ORIGINAL BOILER installation in this plant was made about 1906 and consisted of three 250 hp box-header boilers set in one battery. As was usual at that time the boilers were supported on the brick work. About 1941 a change was made to oil as fuel, with steam atomizing burners, and the furnace floor and a firing area in front of the boilers lowered (also the columns and I-beams were added to support the front of the boilers) as shown in Fig. 1. The stack was supported on the boiler setting brickwork at the rear, having a flattened funnel base which spanned the damper openings of the three boilers.

In 1952 the mortar of brickwork of the middle walls of the battery had disintegrated to such an extent that these walls were collapsing, the side tubes of the boilers were bowed in and more serious trouble seemed imminent. Estimates were obtained on repairing the settings, but the cost including provision for supporting the stack while this repair was going on seemed excessive, considering the probable remaining useful life of the boilers. It also seemed questionable whether this repair work could be done during the annual vacation shutdown, and a stop in production was too costly to consider.

Business of this company is steel-working, and the steam load fluctuates rapidly over a rather wide range. The existing boilers held a rather large volume of water, and with a rather elementary and slow-acting combustion control provided much of the peak steam demand by drawing on the heat stored in the water. This resulted in considerable boiler pressure variations.

In considering a new installation it seemed that a similar plan might be more economical in fuel, if maintaining a slowly varying rate of combustion with good control of the fuel-air ratio and allowing the steam pressure to fluctuate as required above the working minimum. Steam load was determined as between 25,000 and 30,000 lb per hour, and the installation was planned for three boilers of 16,000 lb per hour maxi-

Fig. 2. Outside view of boiler house addition, showing rear of steel-cased new boilers and support for the flue

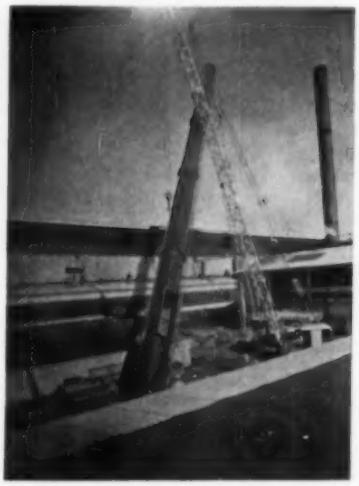


Fig. 3. New steel stack was erected with long boom cranes. Its foundation can be seen just left of crane truck

cating pump and heater set, deaerating feedwater heater, boiler feed pumps and exhaust receiver and installing and piping of combustion control		
Thermal insulation	Cummings Insulation Co	3,021
Combustion control	Standard Instrument Corp	4,123
Building alterations, excavation and foundations for boilers and stack	Hewlett Construction Co	26,637
Electrical work	Owner's maintenance force	1,500
Flow meter orifice	Minneapolis-Honeywell	17
Governor parts for boiler feed pump turbine	Terry Steam Turbine Co	87
New runner for boiler feed pump	Worthington Corp	246
Engineering	Westcott and Mapes, Inc	14,076
Engineering expenses	Westcott and Mapes, Inc	432
Estimated Cost...$179,330	Actual Cost....$184,008	
Cost per lb per hour normal steaming capacity—		$3.83

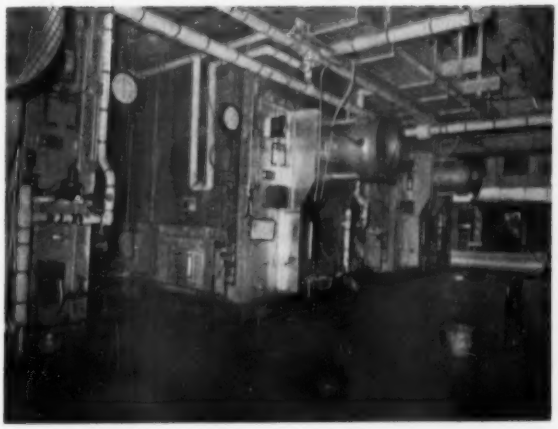


Fig. 4. Three new boilers have 16,000 lb hr maximum are of two-drum, bent-tube type with water-cooled sidewalls

Modernize Small Power Plants

Fifth in a series of six industrial jobs selected for cost analysis

mum capacity in the extra large drums, approaching the water capacity of the existing boilers. These new boilers are of the two-drum bent tube type with furnace sidewalls water cooled by spaced tubes. They have steel casings lined with refractory tile and insulation.

Existing boiler house was the most convenient location with regard to steam-using equipment and for economy of attendance on the adjacent air compressor installation. As steel-cased boilers are suitable for semi-outdoor installation, it was at first proposed to cut an opening in the boiler house wall opposite the existing boilers and set the new boilers with the top drums and their accessories just inside this wall. The final decision was to position the boilers at this same location but to remove all of the wall, extend the boiler house roof on its existing slope and close the space at the back of the boiler alley ways. Part of this structure is shown in Fig. 2.

Foundation conditions were not favorable for a self-supporting stack, and good anchorages on adjacent steel building frames were available, so a guyed stack was installed. This had a 60-in. dia, was 145 ft high, and erection was quite a problem as there was barely enough room in the mill yard adjacent to the foundation to assemble it on the ground. Two cranes were used, one with a very long boom, as shown in Fig. 3.

Much existing equipment was used. The fuel oil tanks visible to the left of the stack in Fig. 3, the pump and heater set, the feedwater heater and boiler feed pumps were all usable and as required were moved to new locations. Figure 4 shows the new boilers. The oil burners are of the forced-draft register type with steam atomization, lighted manually, the forced draft fans of the motor-driven axial type being mounted on the windboxes above head height.

Space formerly occupied by the old boilers was made into a change room for the mill workers.

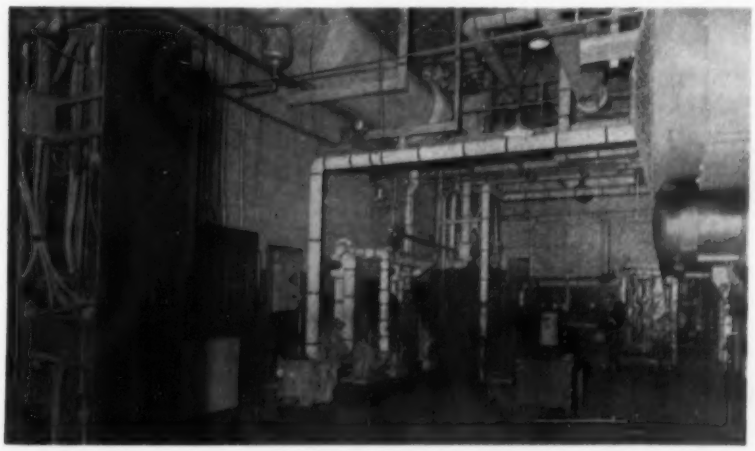


Fig. 5. Boiler auxiliaries on other side of firing aisle. Part of control board, left

*Consulting Engineer, Westcott & Mapes, Inc, New Haven, Conn.

Power Engineering handbook

What You Should Know About Lubricating Elevator Ropes

By PAUL C. ZIEMKE

RED DUST and red rouge are terms descriptive of conditions experienced by elevator maintenance engineers in their work of lubricating the hoist ropes used on traction-type equipment. The condition develops as the result of abrasion between the steel wires that form the twisted layers of rope and the inner fiber core or center.

This peculiar condition results when the lubricating oils originally impregnated in the fibre core become dried out through oxidation and the squeezing action of the rope under the stress of loading, plus the wedging action imposed by some types of traction drum grooves. The red dust is produced by the abrasion of the individual wire strands as they rub against each other under the tension induced by the moving elevator. This dust is produced by oxidation, since it is essentially powdered rust. The dust lodges in the valleys between the strands, and its presence at that vital point accelerates abrasive action which in turn causes more dust. The aggravated condition then manifests itself by the layer of dust that collects on the floor of the machine room, with some of it drifting down the shaft to form a sprinkling on the deck of the car enclosure.

Quantity of metal worn off the individual strands is, obviously, indicative of wear where wear should be prevented if possible. The really serious fact revealed by the presence of the red dust is that the fiber core has lost all of its original oil content. The oil must be replaced to stop the abrasive action.

A light-bodied oil is recommended since it will penetrate into the valleys of the rope and then through the dry fiber core, to stop the initiation of abrasive action at its inception. There are several grades of oil available for this special purpose, thanks to the continuing efforts of several oil companies and elevator builders.

How to Apply the Oil

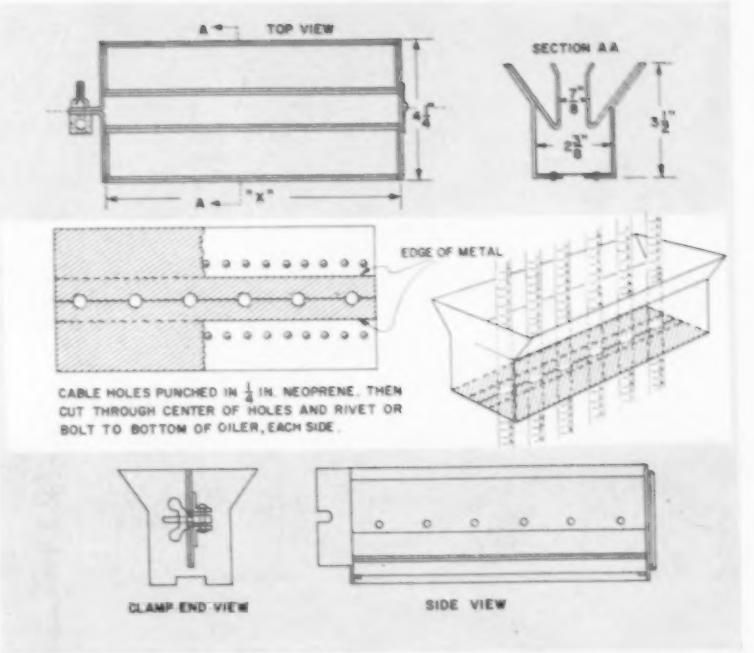
Some elevator engineers apply the oil by the simple technique of brush application as the car is slowly moved in the shaft. However, this is not a very satisfactory method since the application is apt to be spotty, to say the least, and any excess of oil will run down the rope onto the roof of the car.

Other engineers use a slightly more elaborate system. A stout sheet-metal box is used, closed at one end by a piano hinge and at the other with a toggle clamp. The slot in the bottom of the box is closed by cementing in two strips of Neoprene rubber that overlap, with holes punched in them slightly smaller than the diameter of the rope to be oiled. This arrangement creates an oil-tight bottom for the box so that oil may be slowly poured into the open top as the rope feeds through the special Neoprene-sealed bottom. See figure.

The car is brought to the top of the shaft and the box is clamped around the

POWER ENGINEERING

fold along this line—outside edges toward you


A
TOP VIEW
SECTION AA
"X"
EDGE OF METAL
CABLE HOLES PUNCHED IN 1/4 IN. NEOPRENE. THEN CUT THROUGH CENTER OF HOLES AND RIVET OR BOLT TO BOTTOM OF OILER, EACH SIDE.
CLAMP END VIEW
SIDE VIEW

Oiler box for use on elevator ropes has bottom sealed with two halves of Neoprene sheet with holes punched down center in size slightly smaller than diameter of ropes. This affords a squeegee grip on ropes. The fit should be so secure that the oil merely seeps down the cable valleys as it passes through the oiler, then spreads by capillary attraction to core. Neoprene sections slightly overlap

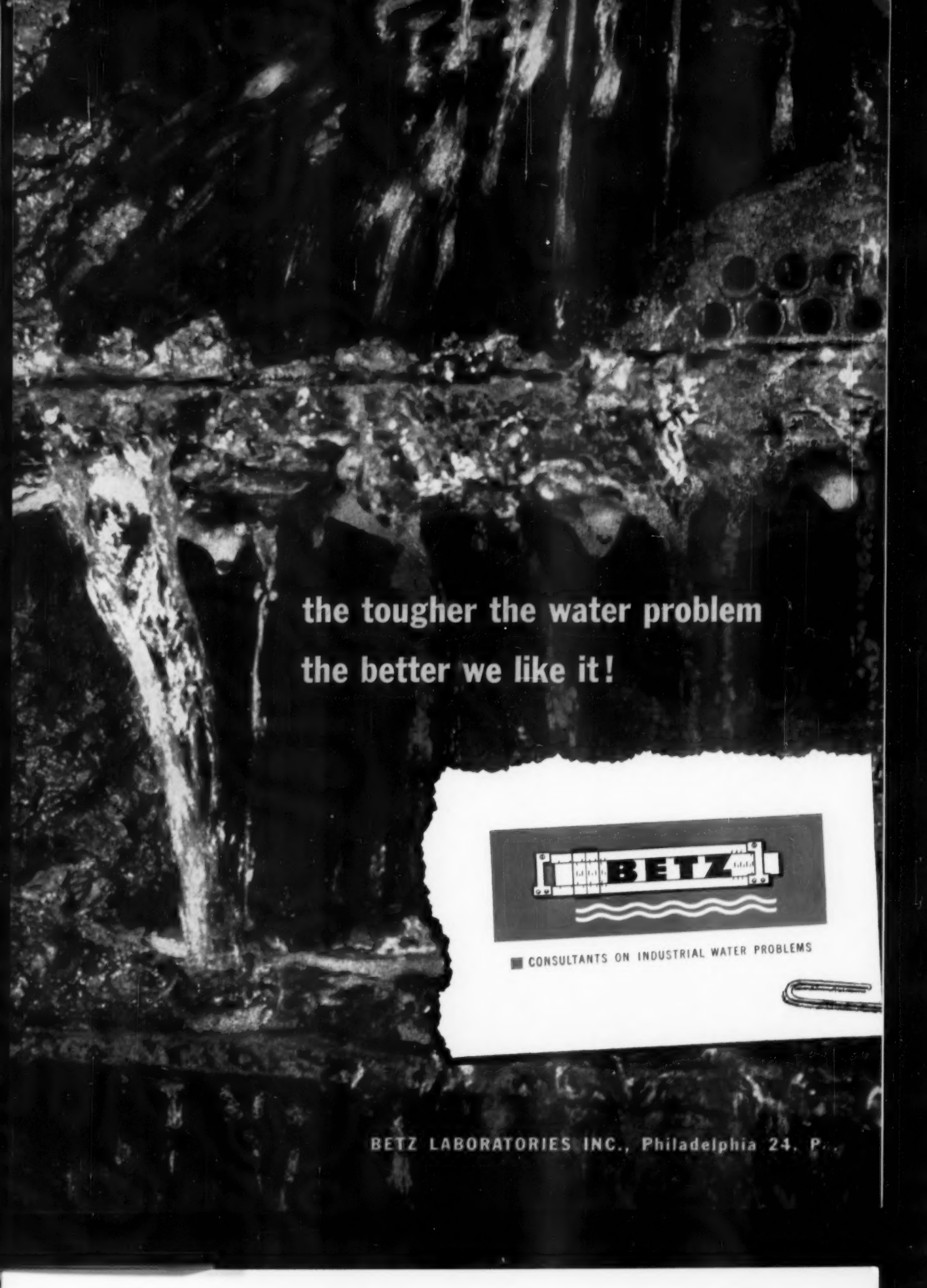
cables. The box is then filled and the car started down (at the lowest speed) until it reaches the shaft bottom. Next the box is placed on the counter-balance side of the drum and the car is brought up the shaft.

The possibility of leaks developing around the piano hinges and the Neoprene strips is very real. A certain amount of messiness should be expected, and plenty of rags kept on hand to use in dealing with incipient leaks. It's a help also to lay down a floor of red resin paper, or heavy used packing cardboard, which can be picked up and burned as soon as the job is finished.

It is not necessary to erect an expensive stage in the shaft below the penthouse, unless the machinery is located in the pit annex and the car lifted and lowered by sheaves located in a miniature penthouse (or "dog-house," in elevator parlance) which protrudes up into the roof but has no opening thereto. In such an installation, a stage of sorts must be built above the extreme upper travel of the car, to reach all the rope reeved on the sheaves.

However, this type of installation is rarely used for more than two floors, so the erection of the stage is not too expensive, if shaft wall protrusions occur upon which to anchor it. Owners of such an installation, who intend to embark on a periodic lubricating program, should cut an opening into the miniature penthouse. This will pay off in labor saved in the lubricating process, as well as

cut along this line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making periodic inspections easier.

Choose the Right Oil

The success of the oiling program hinges largely on the correct choice of lubrication. Oil of too thin consistency will work down the ropes and badly stain the car enclosure. That is always a mark of the amateur. Whatever type of application is used, it matters little if the fluidity of the oil is characteristic of the lubricant, or is caused by the addition of a thinner. Some oils are compounded with permanent thinners and others are volatile in nature and will evaporate to leave the residue of heavy-bodied lubricant. The volatile-type thinner is suggested for the brush method of application. For the more ample and penetrating type of lubrication achieved by the box lubrication method, a permanent type of thinner should be employed.

Some special oils are available which contain a corrosion inhibitor additive, which gives them a greater affinity for penetrating and adhering to the individual components of wire rope. In selecting these special oils it is advisable to choose a type that is non-injurious to the fibre core built into the rope.

A warning should be given against the use of heavy-bodied lubricants which require heating to a condition of fluidity to permit application to the rope. The special equipment needed to perform the heating function is expensive to acquire and maintain. Also, unless steam or hot water is used, the engineer can become quite involved with fire prevention officials, who are usually quite unenthusiastic about such heat sources as gasoline, kerosene, and sometimes electric heat.

Heavy-bodied lubricants appear to produce an excellent seal against the intrusion of moisture or caustic and acid fumes in areas where these are a problem. But the fact is that while the exterior surface may look good to the inspector, actually the lubricating material has not successfully penetrated to the vital fibre core of the rope. With the passing of time, the outer coating of lubricant on the rope dries and hardens so that the flexing over sheaves and traction drums causes cracking of the lubricant's surface. At that stage in the life of that particular application, the engineer may as well not have bothered with the lubricating at all.

Years of experimenting with the various types of lubricants have proved the effectiveness of the light-bodied oils to penetrate well and to cling to the individual wires. Most wire rope manufacturers and the large elevator manufacturers recommend the application of these light-bodied lubricants. The frequency of application is determined by the operating conditions existing for the particular installation.

Two Good Ideas for the Shop

By DONALD L. COCHRANE

WE CHANGED our shop around for purpose of convenience and instead of anchoring down our grinder and drill press as they previously were, we welded them to large heavy bases. Now when we have to grind or drill long or awkward pieces we can move the tools to a place more convenient. Yet for ordinary uses they are close to the wall and out of the way. The bases are heavy enough and wide enough so they cannot be tipped over accidentally. The water tray on the grinder was solid and we changed it to a removable one for easier filling. Tray ears were made to fit in loops attached to the base, for ease of removal.

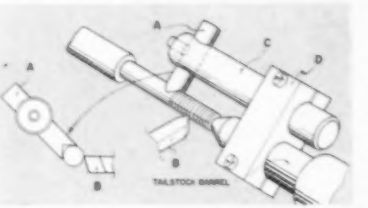
We also improved a detail of overhead crane operation. Previously men operating the crane had pulled the chain at enough of a slant, or flopped it, so that it hit the bare power wires. By welding lengths of pipe on each side of the chain guide it is now impossible for the chain to touch the wire. The ends of the pipe are flared to provide smooth running for the chain when it is pulled at an angle. The pipes extend down nearly level with the bottom power wire.

You may say that the chain should only be operated from immediately below the sprocket and therefore should not get close to the wires. That makes too many extra steps around the catwalk. Also, one man often works alone and cannot do required jobs without pulling chain from a sharp angle.

Fig. 1. Grinder and drill press welded to heavy bases can be moved as needed to any part of shop

Fig. 2. Pipe welded to each side of chain guide for overhead crane prevents power wire contact

Compact Steady-Rest for Small Lathe Work



Rod A with notch engages with the revolving work

By F. E. RILEY

A LIGHT and compact steady-rest for use on small lathe work which is slender is shown in the figure. The steady-rest comprises a single rod of bronze, A, with a V-shaped notch in the end. The notch engages with the revolving work and is placed at an angle so as to resist the combined forces of the turning tool, B.

The bronze rod, A, is supported in a cross hole drilled through the stiff steel bar, C, which is secured to the lathe tailstock barrel by means of the block, D. The block has holes bored to a sliding fit for the support rod, C, and the tailstock barrel, and is locked by saw-cuts which are clamped together by headed screws.

Although slotted-head screws are shown in the drawing, Allen-head screws would be a better choice for clamping the block, D, and the notched bronze support rod, A. Also, file a flat on rod A to take the cupped point of the set screw.

The steady-rest is very easy to set up and has the advantage that it does not restrict the longitudinal movements of the lathe saddle. On small-center lathes there is often insufficient space available on the bed for mounting the standard 3-point steady-rest and a traveling steady is not always available.

Check for Pipe Weakness

By HENRY JOSEPHS

IN OUR STEAM PLANT, the abrasive action of ash in a 10-in. ash disposal pipe wears the pipe thin, but the problem is that the outside of the pipe gives no inkling of when the inside has worn thin.

Our solution was to drill ¼-in. holes partly through the pipe along four sides of it, at about 4-ft intervals. As the pipe wears, the bottom holes begin leaking, at which time the pipe is turned 90 degrees, the leaking holes are pad-welded, and the pipe remains in the new position until the new row of holes at the bottom begins leaking, signifying that it's time to turn the pipe again.

POWER ENGINEERING HANDBOOK

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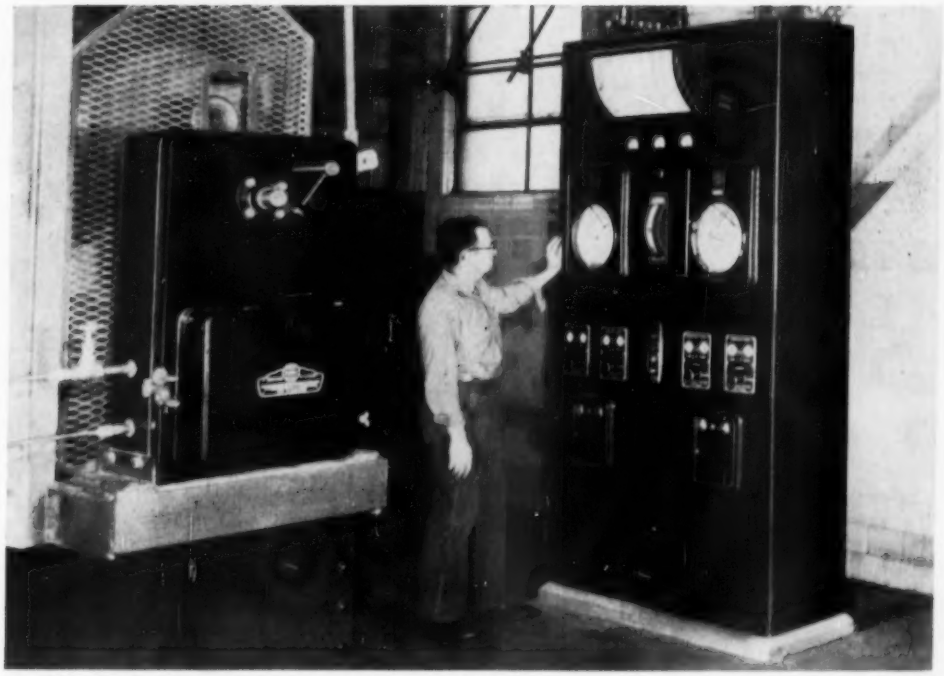

This Bailey Control System helps cut fuel costs on a 70,000 lb per hr capacity 125 psi boiler in an industrial plant. Control drive in foreground regulates stoker.

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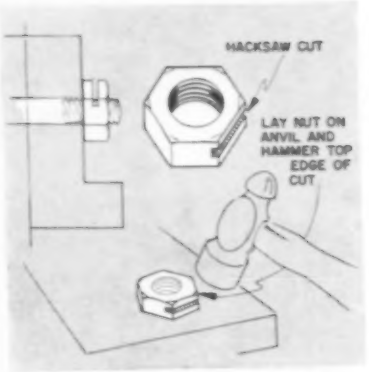

Fig. 1. Quickly-made lock nut remedies lack of cotter or other locking. Hammering deflects lip

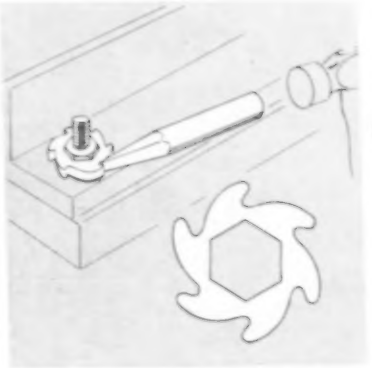

Fig. 2. Handy impact wrench for hard-to-get-at places where flanges and piping are a hindrance

Seven Tips For The Maintenance Man

By CHARLES H. WILLEY

WHEN THAT bothersome nut loosens because there's no means provided for locking it, take the nut off and saw a slot in it, as shown in Fig. 1. Then lay the nut on an anvil and hammer the top part of the nut at the saw cut, to close slightly. This deflects the lip and causes a slight misalignment of the threads at that point. Now when the nut is screwed back on, it will bind and hold securely, without damage to the threads.

In the course of maintenance work, the engineer always has that hard-to-get-at nut or cap bolt to cope with. A big help in such a situation is the impact socket wrench shown in Fig. 2. Make it of tool steel, harden and temper it. It can be used to tighten or loosen depending on the way the lugs are pointed when it is put on. Hammer and drift supply the impact.

Often there is real need for a good beam clamp, such as the one shown in Fig. 3. Flame cut from 1-in. steel plate, it is ruggedly made and fitted with hardened cup-pointed set screws. This clamp can be attached quickly and securely to any beam or place where the opening will fit, and safely used as a chain hoist. If one clamp is not adequate, use two and run a bar through the eye holes and place the hoist hook on the bar.

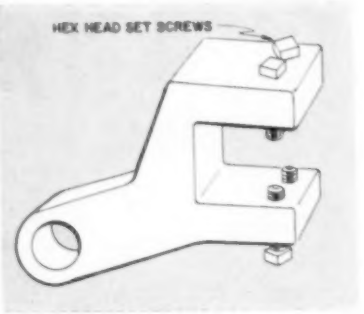

Fig. 3. Eye-type beam made from 1-in. steel plate can be quickly attached and used as chain hoist

fold along this line—outside edges toward you

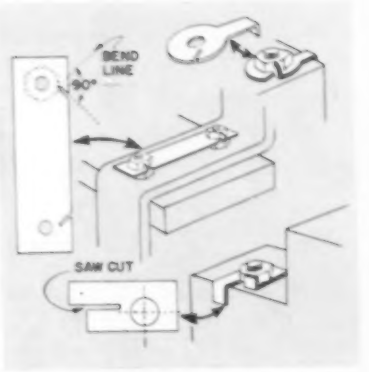

Fig. 4. Lock plates or strips can be made in the shop, are a good way to secure one nut or more

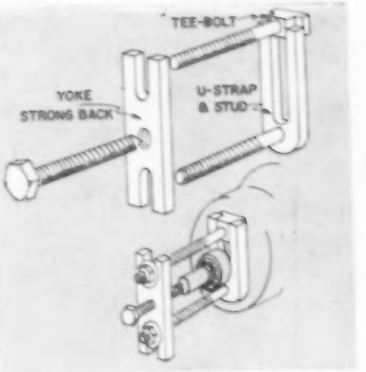

Fig. 5. Bearing-puller acts to prevent injury or distortion because all power is applied at center

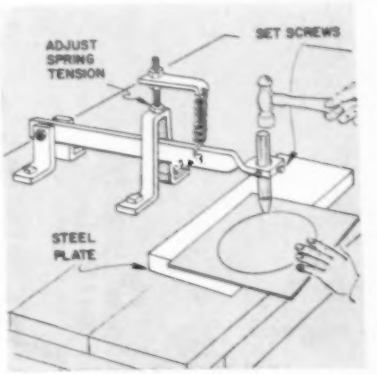

Fig. 6. Third hand for the chisel is result of this rig, which simplifies flat work on a bench plate

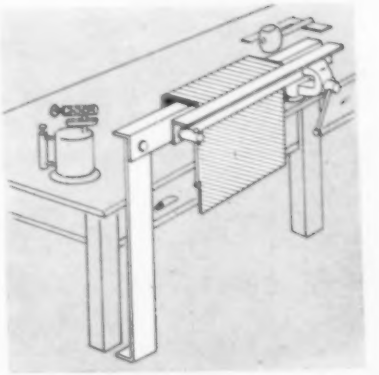

Fig. 7. Simple sheet metal vise can be made for holding metal while forming. Device is collapsible

There are many types of lock nuts, lock washers and similar devices available, and all have their just claims. But sometimes such an item is not at hand when needed and the engineer has to resort to securing the nuts with other means. Perhaps even more versatile than the method shown in Fig. 1, is the lock plate or lock strip shown in Fig. 4. These lock plates can be quickly made from strip steel and cut and drilled to various styles, as Fig. 4 shows. A sawed slot permits the prying up of a lock tab which holds firmly, and which can be made for one nut to an edge, or tied to the next nut. The idea has many applications.

When working with machinery or

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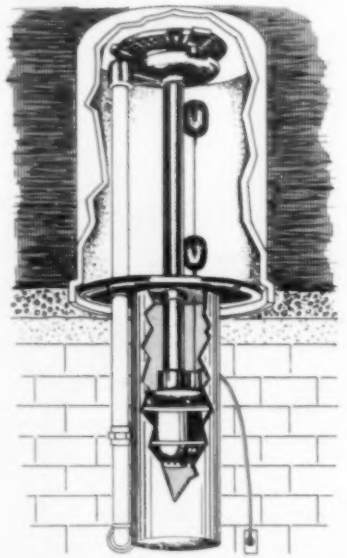
motors having race-type bearings that are a force-fit on the shafts, it is well to make up a set of pullers as shown in Fig. 5. The U-strap with the T-bolt insures the square backing for pulling the bearing without injury or distortion, because all power is evenly applied by the center jack screw, which is pointed to fit the shaft center.

Figure 6 shows how one maintenance man rigged a third hand for himself at the bench, making it very simple for him to manipulate flat work on a bench plate with one hand, and strike the cutting chisel with the hammer in his other hand. The idea is good for gasket work as well, replacing the chisel with a hole punch; and of course gouge or any type of chisel for curved work is adaptable. Also, the rig is suitable for swaging, forming or any heavy type of work.

The inexpensive vise shown in Fig. 7 is very handy for holding that seldom-required job of forming sheet iron, brass or other metal. Called a sheet metal vise, it is made from 3-in. angle iron and a length of ½-in. by 4-in. bar stock for the upright or leg. A bench vise provides the grip at one end, and a through stud at the other. The whole device is collapsible and easy to store when not in use.

Easy Way To Increase Sump Pump Capacity

By J. K. PAUL



Inverted pipe "bell" seals off motor from inrush of water, keeps it pumping even when submerged

THE LITTLE ¼-hp sump pump is a work horse of industry. It's used in almost any elevator shaft that is below the level of the plant sewer or is too far removed to make sewer connection economical. It also serves in many a basement or vault.

This hardworking little Joe labors manfully to keep its head above water when crash conditions occur, but all too often it floods out because of a lack of extra capacity. One quick, effective method to provide increased capacity before flooding occurs is to seal off the motor by the simple expedient of inverting a metal container over it.

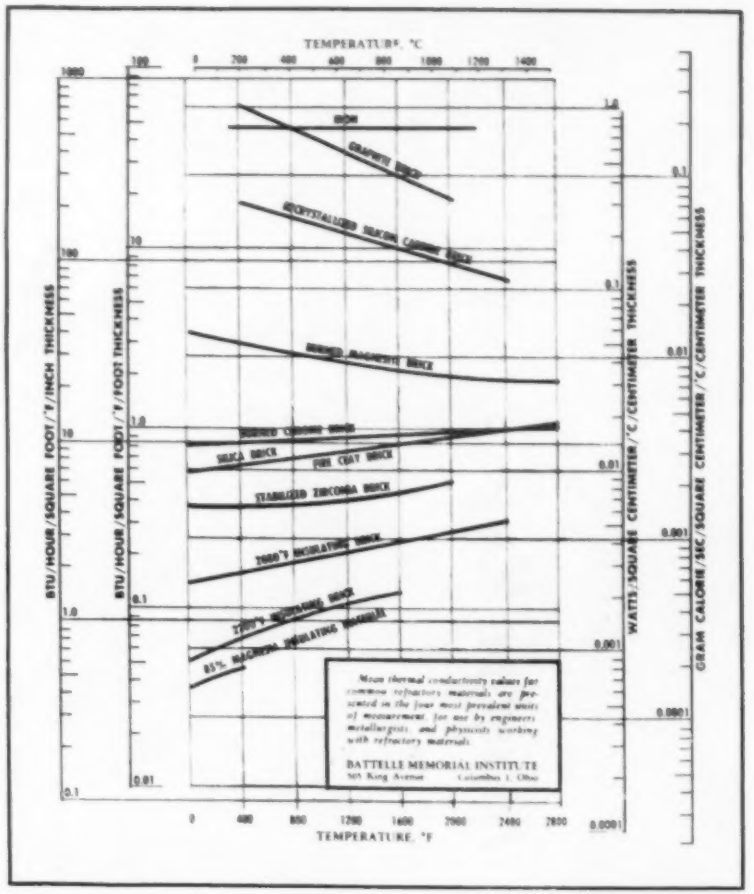
This is done with a piece of standard pipe having an internal diameter of 12 in. One end is sealed off by welding-in a plate, and the bottom rim has a ½ notch cut in it to admit the power cord.

As the water rises faster than the ability of the pump to handle it, the air is compressed in the dome of the pipe section until the pressure is above that of the water seeking entrance. Hence the motor remains dry at all times and continues to pump even when submerged. In time, as the inrush of water diminishes, the pump catches up and eventually the float switch cuts off the power.

The inverted bell needs no anchoring to keep it in place since its weight is sufficient to overcome the buoyancy exerted by the water. However, in cramped quarters such as elevator pits, coal hoppers under railway tracks, or truck dump screens, it is best to weld on a pair of angle irons which have suitable holes for cinch anchoring to the floor. If this is not done, a slight displacement may shift the "can" over just enough to cause the float to jam and so cause failure of the pump to start or stop, depending on where the float was when the jolt occurred.

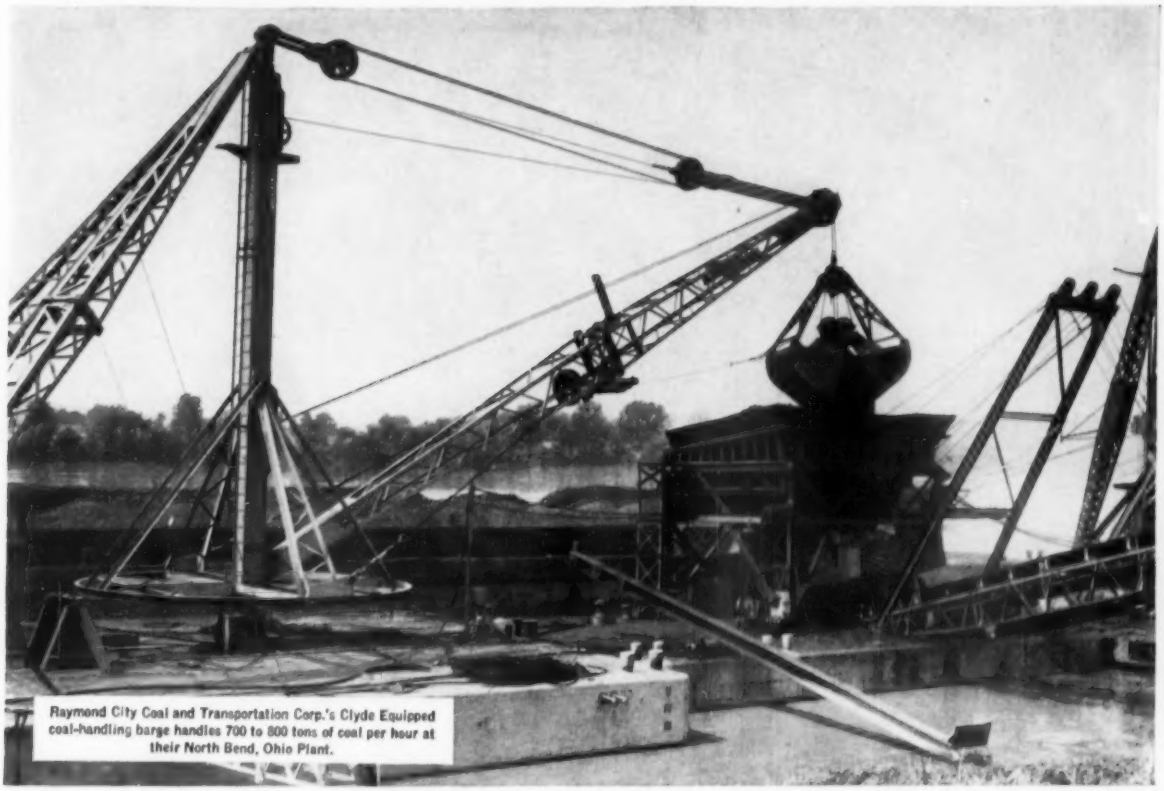
fold along this line—outside edges toward you

Mean Thermal Conductivity Conversion Chart


TEMPERATURE, °C
BTU/HOUR/SQUARE FOOT/°F/INCH THICKNESS
BTU/HOUR/SQUARE FOOT/°F/FOOT THICKNESS
WATTS/SQUARE CENTIMETER/°C/CENTIMETER THICKNESS
GRAM CALORIE/SEC/SQUARE CENTIMETER/°C/CENTIMETER THICKNESS
IRON
GRAPHITE BRICK
CRYSTALLIZED MAGNESIA CHROME BRICK
FUSED MAGNESITE BRICK
FUSED CHROME BRICK
SILICA BRICK
FIRE CLAY BRICK
STABILIZED ZIRCONIA BRICK
INSULATING BRICK
INSULATING BRICK
85% MAGNESIA INSULATING MATERIAL
Mean thermal conductivity values for common refractory materials are presented in the four most prevalent units of measurement, for use by engineers, metallurgists, and physicists working with refractory materials.
BATTELLE MEMORIAL INSTITUTE
505 King Avenue Columbus 1, Ohio
TEMPERATURE, °F

cut along this line

How Clyde Equipment Lowers kw Cost



Raymond City Coal and Transportation Corp.'s Clyde Equipped coal-handling barge handles 700 to 800 tons of coal per hour at their North Bend, Ohio Plant.

FREE DIGGING UP TO 800 TONS OF COAL PER HOUR

A Clyde Barge Derrick loads the coal into a barge mounted hopper. Conveyors then carry it to stock piles, railroad cars or storage bins. Ease of operation, fast cycling, and the long-life dependability of Clyde material handling equipment make this Raymond City set-up "free from trouble since its installation."

Clyde Team Cuts Handling Costs

The Clyde Derrick is only part of this lower-cost material handling story. A powerful, efficient Clyde Hoist and Swinger actuates the bucket and derrick swiftly, easily and safely.

Other Clyde team mates: Two Clyde Barge Movers accurately position the coal barges as unloading progresses. Two Clyde Capstans handle the derrick barge mooring lines.

There's more profit and production in this engineered team by Clyde! Why not capitalize on Clyde's fifty-eight years of engineering and manufacturing achievements. Let the records of proven performance help reduce your material handling costs. There's no obligation.

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UNLOADERS : CAR PULLERS : ROLLERS

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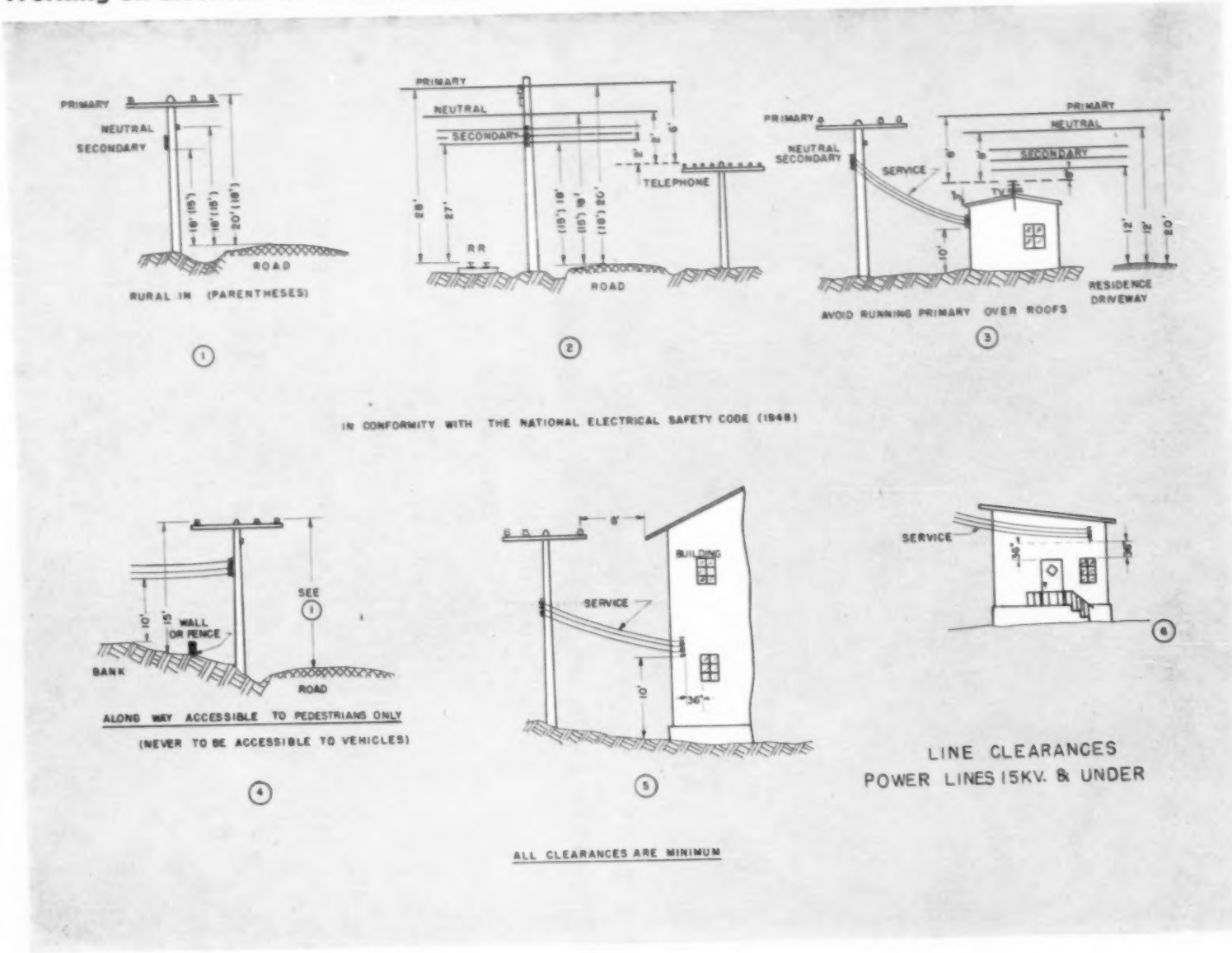
Working on Electrical Distribution Systems? HERE'S A HANDY GUIDE BY H. A. MARTIN, P.E.



cut along this line

EDISON'S OMNIGUARD

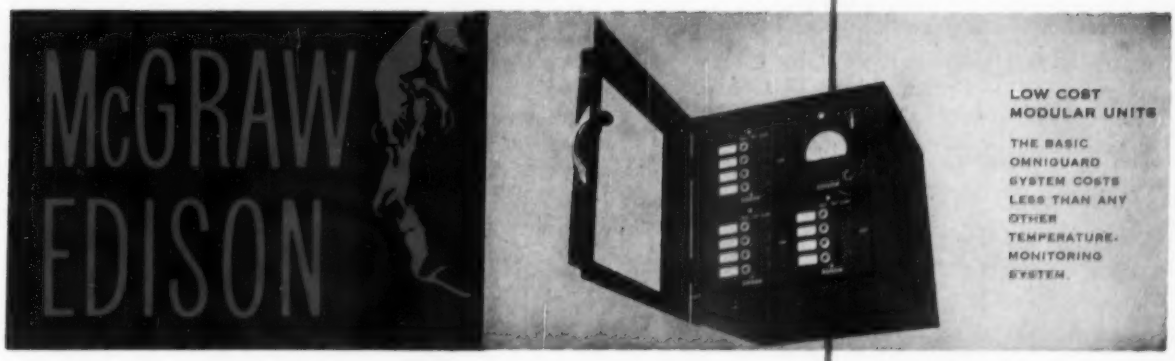
CONTINUOUS TEMPERATURE MONITORING EXTENDS SLEEVE BEARING LIFE

Sleeve bearings are a critical factor in the output of any continuously operating plant. An increase in temperature of **only 20°F** above 180°F cuts bearing life almost in half; hot-running bearings can lead to costly maintenance and downtime.

The Edison Omniguard Temperature Monitoring System, inherently sensitive to minute temperature changes, simultaneously alerts an operator or attendant when even the smallest temperature change occurs. This means that not only can dangerous bearing temperatures be detected well in advance of emergency conditions, but bearing life is greatly extended.

A small plug-in control box and resistance temperature detectors comprise the entire multi-point thermometer system. There is no scanning mechanism to delay the warning signal, few moving parts, no electronic tubes, and no costly circuitry. One **simplified** system eliminates the inaccuracy, danger and expense of attendants checking bearing temperatures by hand.

Omniguard is in use in thousands of installations continuously improving plant operation and lowering maintenance costs for production personnel from coast to coast. Write today for complete technical information.



Thomas A. Edison
INDUSTRIES
INSTRUMENT DIVISION
WEST ORANGE, N. J.

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HAGAN RING BALANCE FEATURES—NO. 2

SAFE SENSITIVE METERING at 2500, 6000, 15000 PSIG

Rear of Ring Balance Meter with side and top panels removed to show S-tube arrangement. Note the push rod and resistant spring assembly, visible back of S-tube and ring. This feature of the Ring Balance makes possible high sensitivity at low flows and simple adjustment of meter range.

No question about it. The cylindrical tubing used to form the ring and S-tubes of the Hagan Ring Balance meter is the safe, sure means for containing high pressures. There are no gaskets or stuffing boxes to leak, blow out, bind or otherwise spoil this ideal design.

Pressure impulses are brought from the meter terminals to the ring through solid-wall S-tubes which, because of their special configuration and metal-to-metal fittings, provide safe, completely flexible connections and preserve the inherent high sensitivity of the meter.

New, rigid, weatherproof, die-cast, aluminum case. Four-piece back for complete accessibility.

Check these other Ring Balance features with your local Hagan office

1. High sensitivity at low flows due to unique range calibration system.
2. Ease of calibration under operating static pressures with factory-calibrated check weights. No more four-story water columns and telephones.
3. Sealing fluid density and level not critical. No eye-droppers required.
4. Interchangeable ring assemblies for full scale ranges from 0.5″ w.c. to 560″ w.c. Adjustment on any one ring over a 7:1 differential range.
5. Wide range computation and/or compensation by means of built-in, easily checked mechanisms available on most models.
6. Pneumatic or electric transmission also available.

Bulletin MSP-141 describes these features and the new design of the Hagan Ring Balance meter case. ASK US FOR IT.

HAGAN CHEMICALS & CONTROLS, INC.

HAGAN BUILDING, PITTSBURGH 30, PENNSYLVANIA
DIVISIONS: CALGON COMPANY, HALL LABORATORIES
IN CANADA: HAGAN CORPORATION (CANADA) LIMITED
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Coal-Handling Tractor Shovel HAS BIG BUCKET . . . WILL TRAVEL

Will travel . . . there's the key to the extra value of an Allis-Chalmers HD-11G tractor shovel with 3¾-yd coal bucket. Its combination of capacity and mobility may be utilized in many ways.

TRAVELS ON THE STOCKPILE Long crawler tracks give it the stability to work right up on the storage pile . . . enables it to spread coal in horizontal layers. This eliminates the formation of flues — the main cause of spontaneous combustion.

TRAVELS ABOUT THE YARD The HD-11G builds stockpiles with equal ease anywhere in the yard. There is no need to limit storage piles to areas served by fixed structures.

TRAVELS FROM JOB TO JOB There need be no idle time for an HD-11G for it is also an expert at countless additional jobs. It can remove and load cinders, help on plant road maintenance, clear and load snow . . . handle many other yard maintenance jobs.

Let your Allis-Chalmers construction machinery dealer show you how the HD-11G can bring new efficiency to your coal-handling operation — and also eliminate the need for specialized machines. Ask to see the three other tractor shovel models, with coal buckets ranging from 2¼ to 7 cu yd. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS *Engineering in Action*

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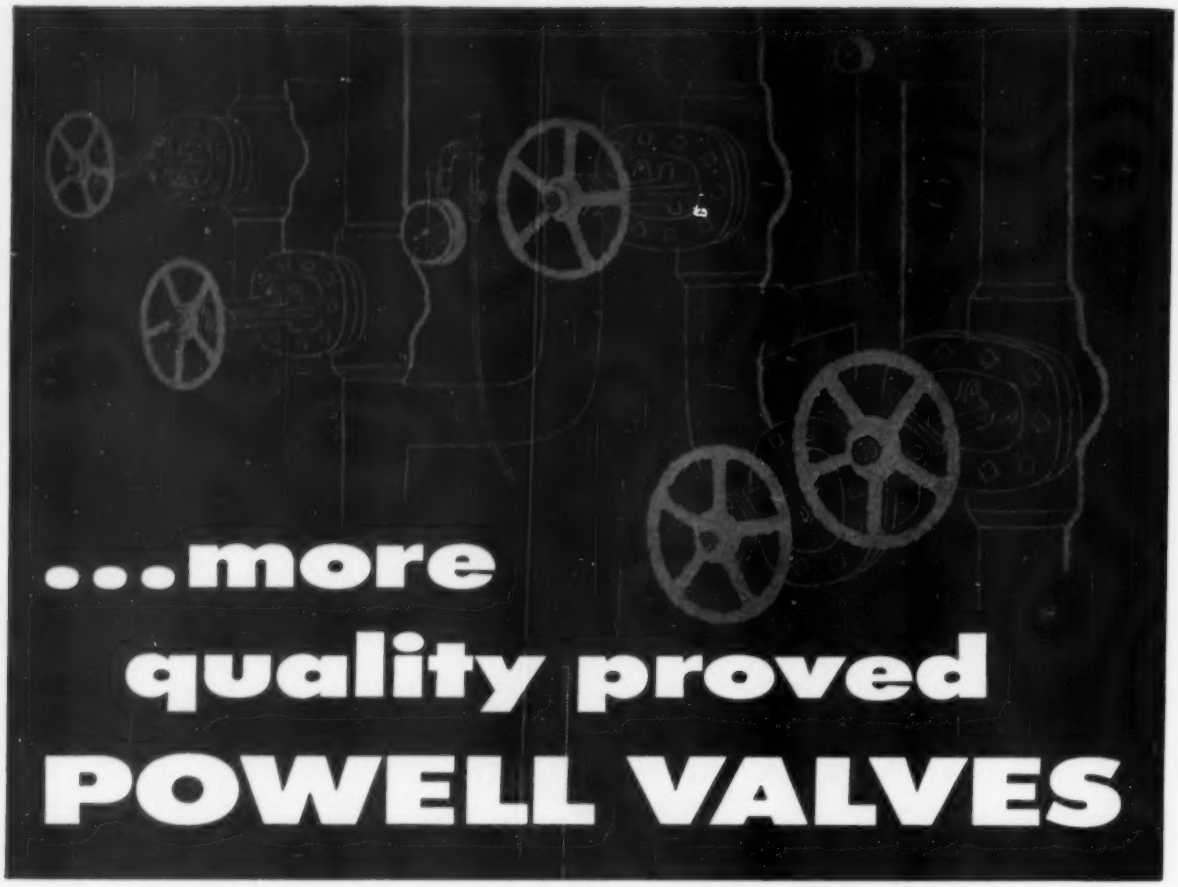

...more quality proved POWELL VALVES

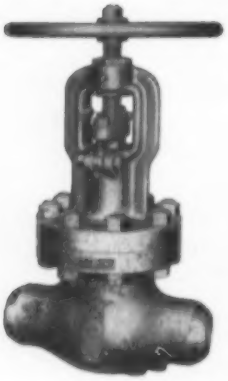

Fig. 6031S-WE—600-Pound Steel Globe Valve for Steam Service. Outside Screw Stem and Yoke.

Fig. 19003—Powell Steel Pressure Seal Gate Valve for 900 Pounds W.S.P.

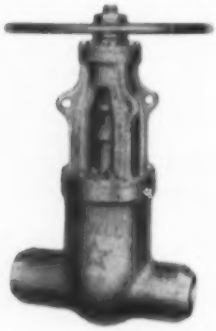

Fig. 2467—Small 300-Pound Stainless Steel O.S.& Y. Gate Valve. For handling boiler feed water treating solutions.

Fig. 1793—Iron Body Bronze Mounted O.S.& Y. Gate Valve for 125 Pounds W.S.P.

made with quality proved materials

Consult your Powell Valve Distributor for full facts about quality proved bronze, iron, steel, and corrosion-resistant valves. For every flow control problem—there is a Powell Valve to solve it . . . *better.*

THE WM. POWELL COMPANY, CINCINNATI 22, OHIO . . . 111th YEAR

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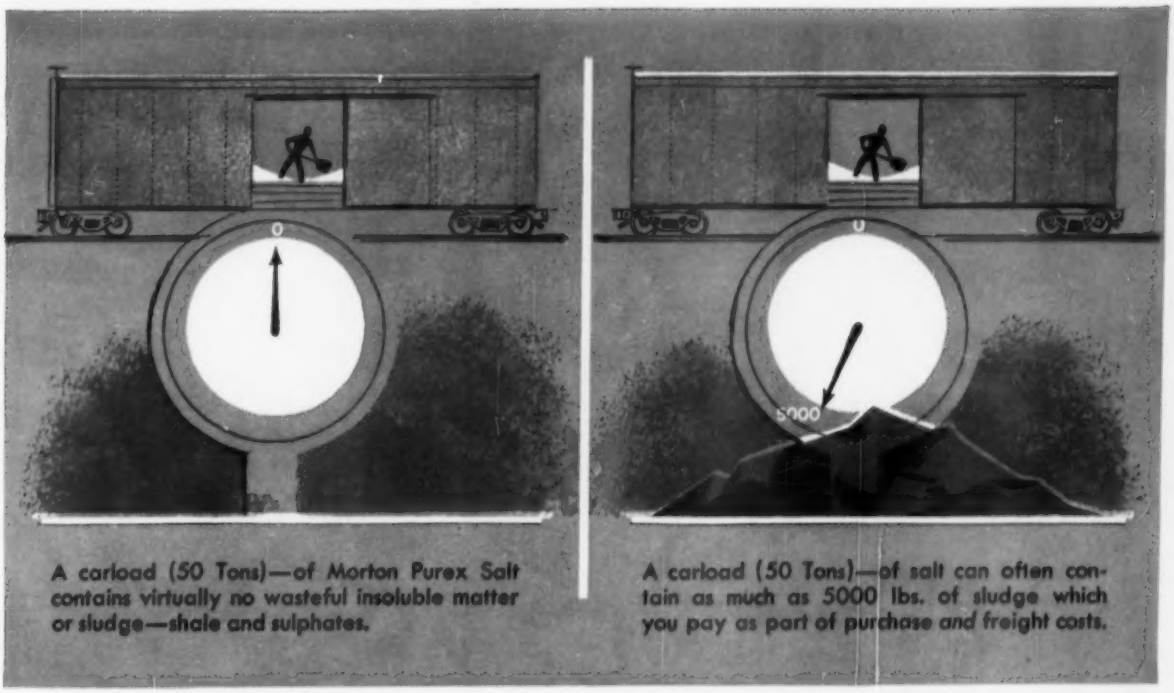
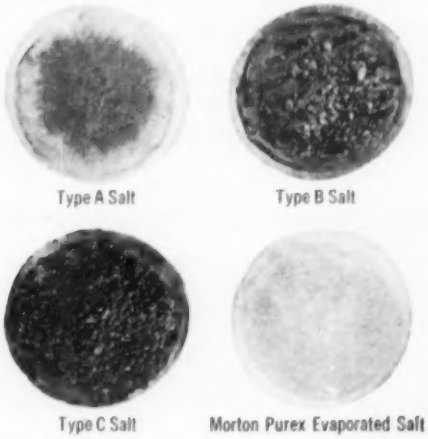


A carload (50 Tons)—of Morton Purex Salt contains virtually no wasteful insoluble matter or sludge—shale and sulphates.

A carload (50 Tons)—of salt can often contain as much as 5000 lbs. of sludge which you pay as part of purchase and freight costs.

Stop paying for wasteful sludge —switch to Purex Salt

These filter pads (approximately 1/5 actual size) show you how much insoluble matter (sludge) you get in just 5 lbs. of various kinds of salt.



Type A Salt | Type B Salt

Type C Salt | Morton Purex Evaporated Salt

Tests for insolubles taken from random samples show you that Morton Purex is the only one that contains no wasteful sludge or insolubles.

For more information about Morton Purex Salt, and for free, expert help on any water-softening problem, write:

When you buy Morton Purex Salt, you get high purity evaporated salt that is made in a controlled-particle size to prevent packing and channeling. With Purex, none of your purchase price or freight bill goes toward paying for useless, troublesome insoluble matter.

With Morton Purex, no time or labor is wasted in cleaning out insoluble matter from your brine making system to keep it functioning at peak capacity. For Purex is 100% soluble. Morton Purex will leave no accumulation of material in either brine or water softener tanks. It can be used in wet-storage systems, and in the Morton Model-E Brinemaker.

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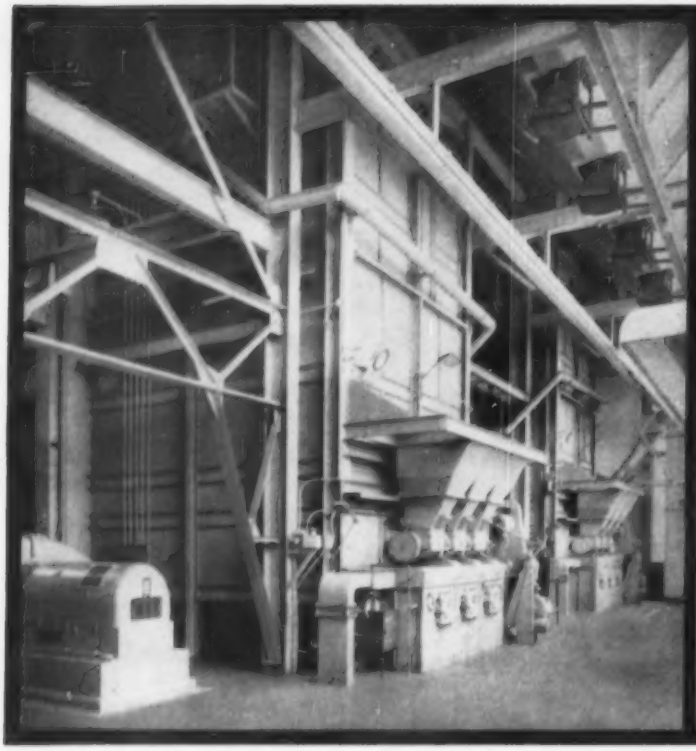

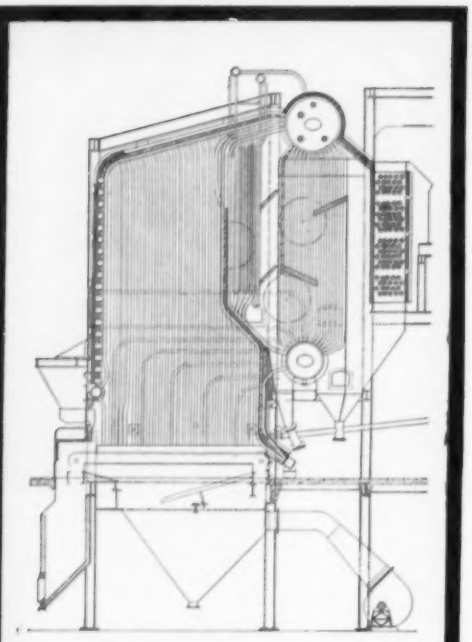

Longitudinal section of Union VO Type Steam Generator.

Union Boilers score new high at Notre Dame with 83% efficiency

Spread over a 1700-acre campus near South Bend, the University of Notre Dame is a self-sustaining community of 6,000 students and 500 faculty members.

To meet the demands of increasing enrollments, as well as to handle its own power requirements, the University expanded its steam heating plant and converted it to a steam-electric power plant. Three of the four original boilers were replaced with a pair of Union 2-drum VO Type Steam Generators. Spreader-stoker fired, each unit is equipped with a superheater and an economizer. Normal rating is 70,000 lbs./hr. at 470 psi and 750° F.

Although the heating load is increased 20%, and electric power is now supplied for all 75 buildings on the campus, boiler efficiency has been upped from 68% to more than 83%. *Coal consumption remains unchanged!*

This is just one job report where Union efficiency and dependability have achieved top-notch economy of operation. Across the nation, Union Boilers are giving similar service to industrial, institutional and public power plants, providing day-in and day-out, the best performance value in modern steam generating equipment.

GET FULL DETAILS

Information on the several types of steam generators built by Union is yours for the asking. Write for illustrated Catalog GB-153.

Aerial view of Notre Dame — with 75 buildings on a 1700-acre tract, this campus is a city in itself.

Steam-electric power plant makes campus community independent of outside power sources.

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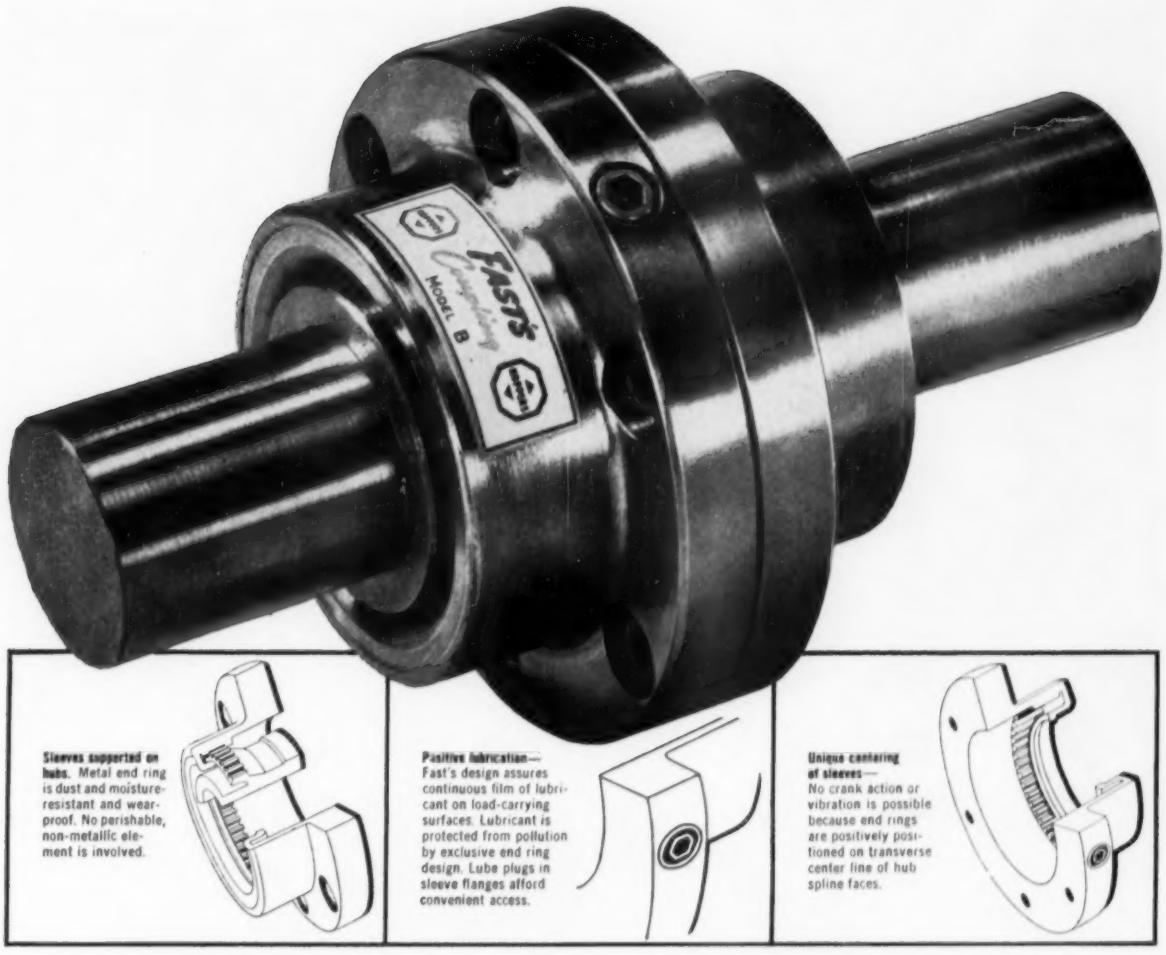
FAST'S
Coupling
MODEL B
Sleeves supported on hubs. Metal end ring is dust and moisture-resistant and wear-proof. No perishable, non-metallic element is involved.
Positive lubrication— Fast's design assures continuous film of lubricant on load-carrying surfaces. Lubricant is protected from pollution by exclusive end ring design. Lube plugs in sleeve flanges afford convenient access.
Unique centering of sleeves— No crank action or vibration is possible because end rings are positively positioned on transverse center line of hub spline faces.

Fast's Model B coupling reduces downtime and upkeep for light-to-medium drives

Mechanical flexibility eliminates costly shutdowns and expensive shaft replacements. But—it's only one of many cost-saving features.

Now you can profit from the durability and economy of famous Fast's couplings in a smaller and lower-cost version—available in 3 sizes for shafts up to 2⅝" in diameter.

The Model B coupling gives you the same features that have made Fast's the world's leading coupling for over 35 years. You get the same trouble-free performance, longer service life and lower maintenance costs. You also get prompt delivery because stocks are on hand to meet practically every need. Free engineering service is also available.

Write today for more details to KOPPERS COMPANY, INC., Fast's Coupling Dept., 3710 Scott Street, Baltimore 3, Md.

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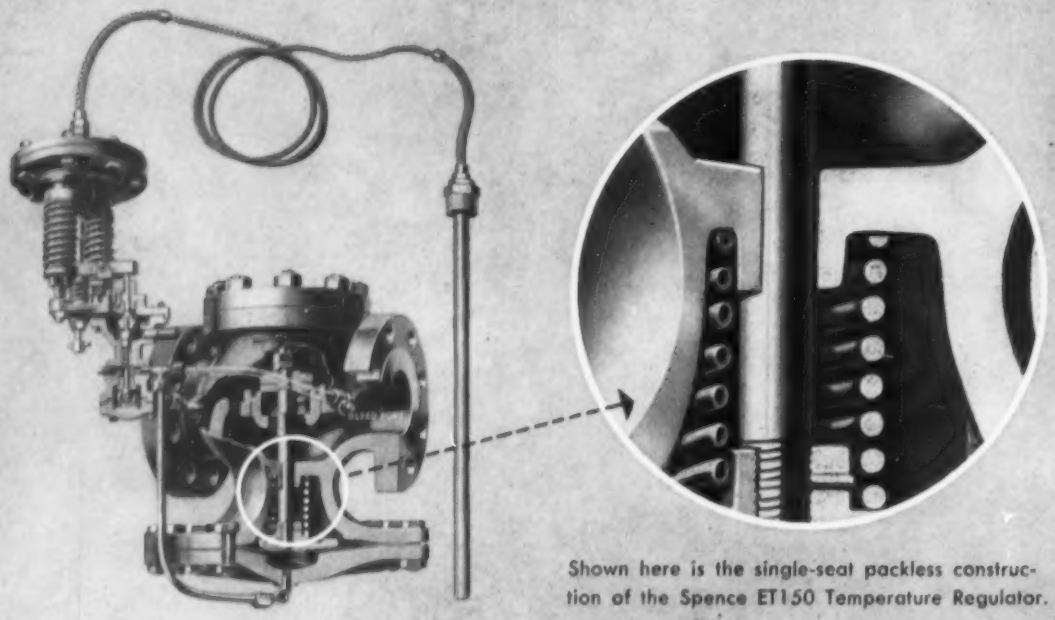
VALVE TIPS:

Advantages of Packless Construction in Temperature Regulating Valves



Shown here is the single-seat packless construction of the Spence ET150 Temperature Regulator.

One of the biggest headaches in regulating valve maintenance is repacking stuffing boxes.

How often a valve needs repacking, how much time it takes, and the cost of the system downtime all vary with the construction of the regulator and the service it's used for. No matter how you calculate all these variables it's still a headache—and an expensive one.

In the temperature regulator shown above (Spence Type ET150) stuffing boxes are eliminated. This is done by what is known as "balanced" diaphragm construction. You can see in the cutaway drawing that pressure is applied to both sides of the large metal diaphragm. The upper side is exposed to delivery steam pressure and the lower side is exposed to loading pressure applied by the pilot. When the pilot closes, both delivery pressure and loading pressure are equalized through the bleedport and connecting tubing.

This construction not only does away with repacking problems, but it makes possible additional savings as well. For example, you will note in the sectional blow-up that this design eliminates a closely fitted stem and guide. Dirt or other foreign matter doesn't have much of a chance to lodge between these parts and cause sticking.

Another cause of binding or sticking, uneven expansion of closely fitted parts, is also eliminated with this design. In addition, valve stem wear is reduced for the same reason.

Lower maintenance is not the only advantage of this packless construction. Accuracy of regulation is also improved because friction due to a stuffing box, dirt, or uneven expansion is not a problem. The large, balanced metal diaphragm is more sensitive to slight changes in pressure.

Guaranteed Not To Wiredraw

If seats and discs are cut by steam (wiredrawn) the loss of steam through these grooves can be another expensive item — directly charged against the regulating valve. Fortunately, you can eliminate these costly leaks by specifying a temperature regulator that is *guaranteed not to wiredraw.*

Spence makes such a guarantee because their seats and discs are made of SECO Metal. Over 20 years experience with this special alloy has failed to produce a single case where a SECO Metal seat or disc had been cut by steam. All that's required is an approved strainer located ahead of the regulating valve. Expensive steam leaks just can't happen with this combination of SECO Metal and single-seat design.

If you would like to have more information on Spence Temperature Regulators, drop us a line and ask for Bulletin T150. It gives more detailed information on these and other Spence design features. Piping layouts and helpful information on the installation of temperature regulators are also included. Write for your copy today.

SPENCE ENGINEERING COMPANY, INC.
Walden, New York

SE 140

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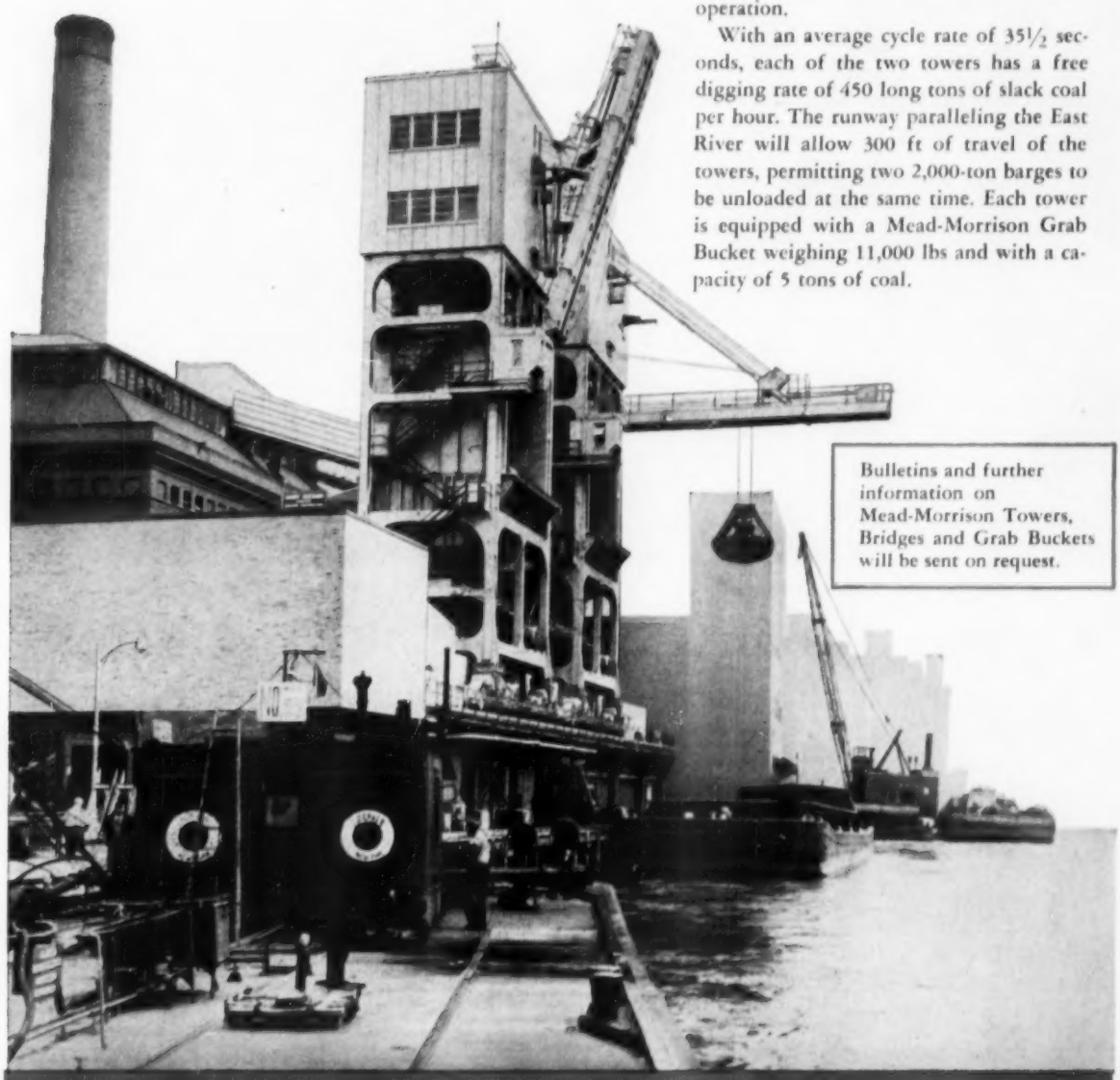
Speedy coal handling

for a New York subway power plant

The power station of the New York Transit Authority at 74th Street and East River has installed two new Mead-Morrison Coal Unloading Towers as part of its extensive modernization program to increase subway power. Because of their prominent position alongside the East River Drive, the towers were specially designed by Mead-Morrison to meet aesthetic standards as well as to include the most modern features for efficient operation.

With an average cycle rate of 35½ seconds, each of the two towers has a free digging rate of 450 long tons of slack coal per hour. The runway paralleling the East River will allow 300 ft of travel of the towers, permitting two 2,000-ton barges to be unloaded at the same time. Each tower is equipped with a Mead-Morrison Grab Bucket weighing 11,000 lbs and with a capacity of 5 tons of coal.



Bulletins and further information on Mead-Morrison Towers, Bridges and Grab Buckets will be sent on request.

MEAD-MORRISON

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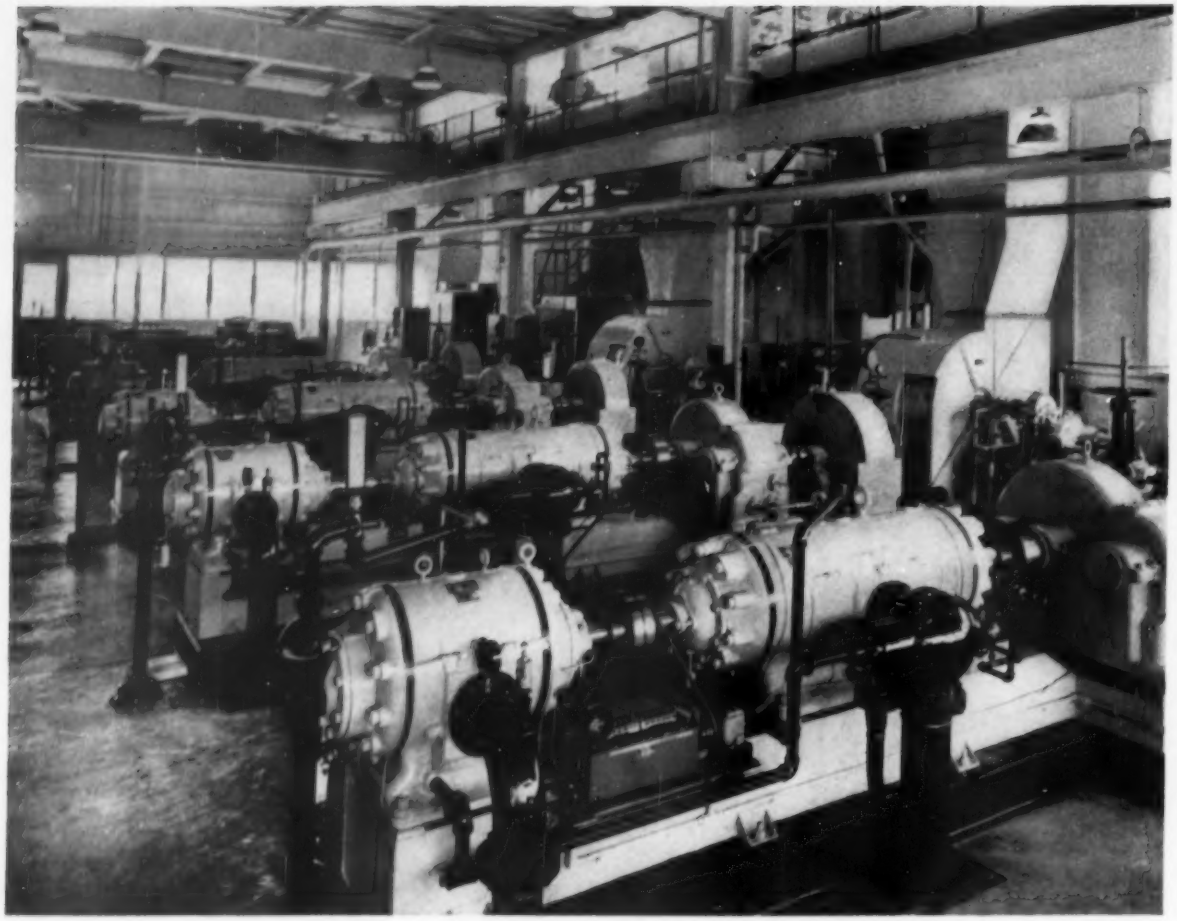

4 YEARS - - 25,000 HOURS OPERATING PERFORMANCE!

This is just one of many production records set by Fuller Rotary Compressors—in this case by each of six machines installed in a leading aircraft plant. The only maintenance or replacement necessary over this period was installation of high and low pressure blades. Bearings held up 100%.

Fuller rotary compressors shown are four C-300-300H, steam turbine drive, capacity each 1248 to 1805 c.f.m., with speed ranges of 450 to 650 r.p.m., 125-lb. gauge pressure, and two electric motor drive, capacity each 1663 c.f.m., at 600 r.p.m., 110 lb. gauge pressure.

Your plant, too, can take advantage of the many cost-saving advantages of Fuller rotary compressors; such as smooth airflow, lack of vibration minimum of moving parts, adaptability to any production setup, and the advantage of "one man" operation.

Write today to Fuller Company and get complete data on how Fuller rotary compressors can give you more air power at less cost.

Fuller

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GENERAL AMERICAN TRANSPORTATION

FULLER COMPANY C-312 4659
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PIONEERS OF HIGH-EFFICIENCY VANE TYPE ROTARY COMPRESSORS SINCE 1930

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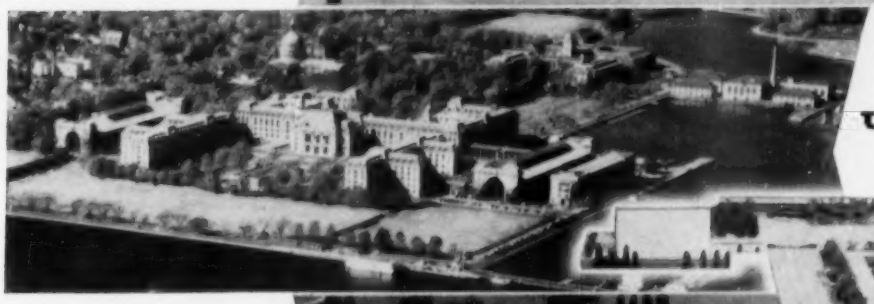
UNITED STATES MILITARY ACADEMY



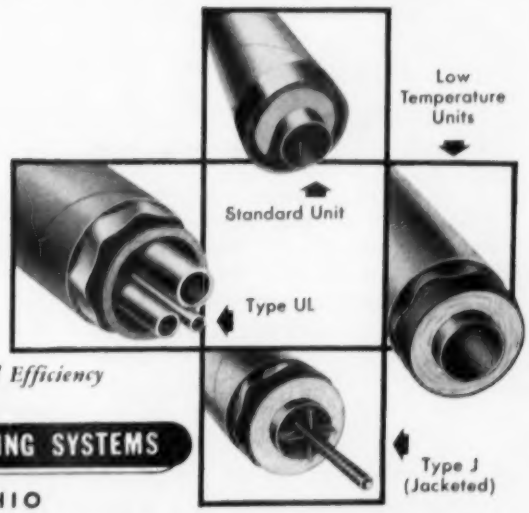
UNITED STATES NAVAL ACADEMY

UNITED STATES AIR FORCE ACADEMY

Photographs courtesy United States Military Academy, United States Naval Academy, and United States Air Force Academy.

Ric-wiL underground piping systems serve ALL three...West Point, Annapolis and NOW...the new Air Force Academy

West Point and Annapolis have been serviced by Ric-wiL piping systems as far back as 1931. Since 1946 alone over 15,000 feet of Ric-wiL prefabricated piping has been purchased for the nation's top military colleges. Installation of Ric-wiL piping at the new 17,500 acre United States Air Force Academy has already been installed. Ric-wiL is indeed proud of the part they have played in serving these military academies for a period of over twenty-five years.



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. . . of Exceptionally High Thermal Efficiency
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BARBERTON, OHIO

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Banish algae scum

from: spray towers cooling ponds
condensers reservoirs
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HTH Granular gives the old heave-ho to algae growths that clog up recirculated water systems, cause heat transfer loss or produce offensive odors.

Containing 70% available chlorine, HTH Granular dissolves immediately to release a fresh hypochlorite solution for sure, fast algae kills. As a rule, about one ounce of HTH per 1,000 gallons of water is enough to control algae growths. Because algae growths form slowly, in most cases only periodic "shot" treatments are required. This, of course, varies with the nature and condition of the specific water supply.

Dry, stable, and easy to use, HTH Granular is the safe, economical way to get rid of algae problems once and for all. It's packed in 100-lb. drums and in cases of nine 5-lb. cans. Check your supplier today or write to us directly.

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INDUSTRIAL CHEMICALS DIVISION • BALTIMORE 3, MD.

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What They Tell Us

continued from page 6

and he only laughed and said that they had no secrets there."

While visiting Amsterdam, Andy said he thought he would take advantage of the opportunity to visit "Het Atoom," the International Atomic Exposition being held there. Being somewhat averse to crowds, he decided that Monday morning might be a good time to go. Most people, he assumed, would be at work and there probably would not be many tourists there. But at ten o'clock Monday morning he found the place so jammed he could hardly get near any of the exhibits. They were of all ages, large and small, young and old, and of all nationalities and, as Andy reported, they were there because they wanted to learn about the atom. Of outstanding interest was the "working" swimming pool reactor. Here, people had to be admitted in groups so they could lean over the rail and see the Cerenkov glow around fuel elements at the bottom of pool.

In London, Andy says, he happened to be in the offices of the Central Electricity Authority on the very day that the big shakeup in that organization was announced in the London morning papers, and that same night he had dinner with John Peattie, the former chief engineer of the Authority, who filled in some of the background of the change in organization. The Central Electricity Authority, it seems, is to be superseded by a new Central Electricity Generating Board. The significant feature of the change, however, is the fact that Sir Christopher Hinton, who has been the managing director of the Atomic Energy Authority, has been appointed chairman of the new Generating Board, and that Lord Citrine who had been chairman of the Central Electricity Authority becomes only a part-time member of the new Electricity Council, the coördinating body of the nationalized electricity industry. Sir Christopher Hinton is the man who built Calder Hall, Britain's first atomic power station; hence the fact that he has been named to head the new Central Electricity Generating Board seems to imply an even greater acceleration of England's atomic power program than has been the case so far.

Out of Andy's contact with power developments in Britain comes an exciting article on Dounreay, the world's first large fast breeder reactor built to produce commercial power. It's scheduled for next month — in POWER ENGINEERING, of course.

POWER POINTERS

Tubing enough to top U.S.A.F. altitude record by 3.1 miles

END TO END, MONEL* NICKEL-COPPER ALLOY TUBES IN AN EASTERN POWER COMPANY'S TWO NEW FEEDWATER HEATERS WOULD REACH 27 MILES ABOVE SEA LEVEL—OVER 3 MILES HIGHER THAN THE UNOFFICIAL ALTITUDE RECORD FOR POWERED AIRCRAFT...7 MILES ABOVE THE NEW RECORD FOR BALLOONS. THE HIGH STRENGTH OF CORROSION-RESISTING MONEL ALLOY PERMITS USE OF RELATIVELY LIGHT 17-GAUGE TUBING IN HANDLING FEEDWATER AT PRESSURES OVER 2000 PSI AND BLEED STEAM TEMPERATURES UP TO 820°F...SPEEDS HEAT TRANSFER.

Secret of seal-less pump: the metal that acts like air

TWO "CANS", ONE WITHIN THE OTHER, ISOLATE STATOR AND ROTOR OF THIS LEAK-PROOF SEAL-LESS PUMP FROM CIRCULATING FLUIDS. "CANS" ARE MADE OF INCONEL* NICKEL-CHROMIUM ALLOY. MAGNETICALLY, INCONEL ALLOY BEHAVES LIKE THE AIR GAP IN AN ORDINARY ELECTRIC MOTOR, CREATES NO MEASURABLE INTERFERENCE WITH MAGNETIC FLUX...HAS NO EFFECT ON MOTOR EFFICIENCY.

Trumpet valve cycles up to 8 times per second in "Flight of the Bumble Bee"

FIRST COUSINS TO INDUSTRIAL COMPRESSED AIR VALVES, TRUMPET VALVES MUST RESPOND TO HIGH SPEED FINGERING. TO PREVENT STICKING, WEAR AND CORROSION—ENEMIES OF TRUMPET AND INDUSTRIAL VALVES ALIKE—A FAMOUS MANUFACTURER MAKES VALVE PISTONS FOR HIS TRUMPETS OF MONEL* NICKEL-COPPER ALLOY. CORROSION-AND-WEAR RESISTANT MONEL ALLOY IS READILY MACHINED, BRAZABLE AND TAKES A HIGHLY POLISHED FINISH.

STUMPED BY A METAL PROBLEM?

PERHAPS GETTING TOGETHER WITH INCO'S MECHANICAL ENGINEERING SECTION WILL HELP YOU COME UP WITH AN ANSWER. FOR A PRELIMINARY BRIEFING, WRITE

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INCO Nickel Alloys

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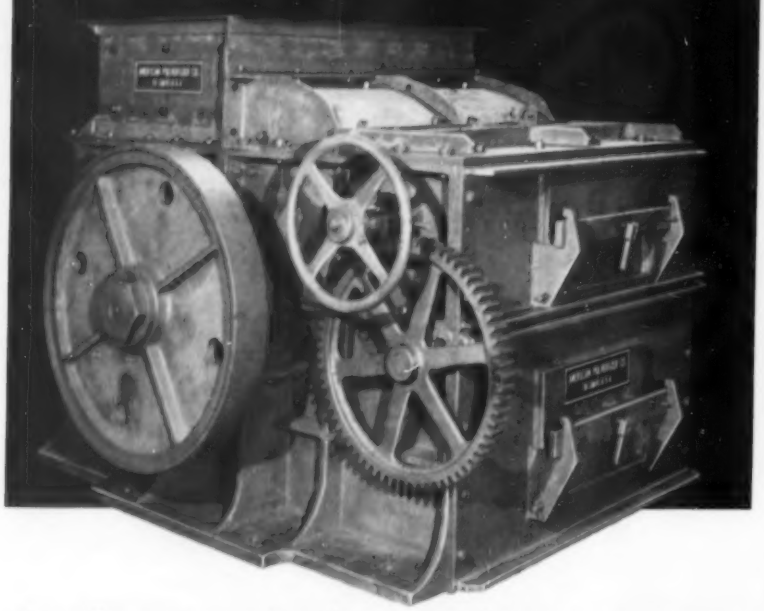
American Coal Crushers are RUGGED!



Soundly engineered and constructed to give you many years of high volume crushing at low operating costs.

1. Oversize bearings.
2. Alloy Steel heat treated rotor shaft.
3. Heavy rib reinforced housing with renewable liners and tramp metal pocket.
4. Manganese Steel crushing elements.
5. Exclusive American-Originated rolling shedder ring which splits coal instead of crushing it.
6. More efficient crushing design which permits slower operating speeds and less power consumption per ton of coal crushed.
7. Dual adjustment to give flexibility of size control and to compensate for wear.
8. Maximum flexibility of rolling ring rotor prevents injury from tramp iron.
9. Full width screening area gives faster discharge of reduced product.

Coal Crushers exclusively, from Sample Crushers to Capacities of 800 TPH
Write for literature stating capacity you need.

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ORIGINATORS AND MANUFACTURERS OF RING CRUSHERS AND PULVERIZERS
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St. Joe Power Costs

continued from page 78

settlement of sludge can occur. The sludge is now being removed by a small dredge, operated by two men on a part-time basis.

The following chemicals are being fed: 30 ppm aluminum sulphate; 2 to 3 ppm sodium aluminate; and sodium hydroxide as needed to maintain 7.3 pH.

Demineralizer Added

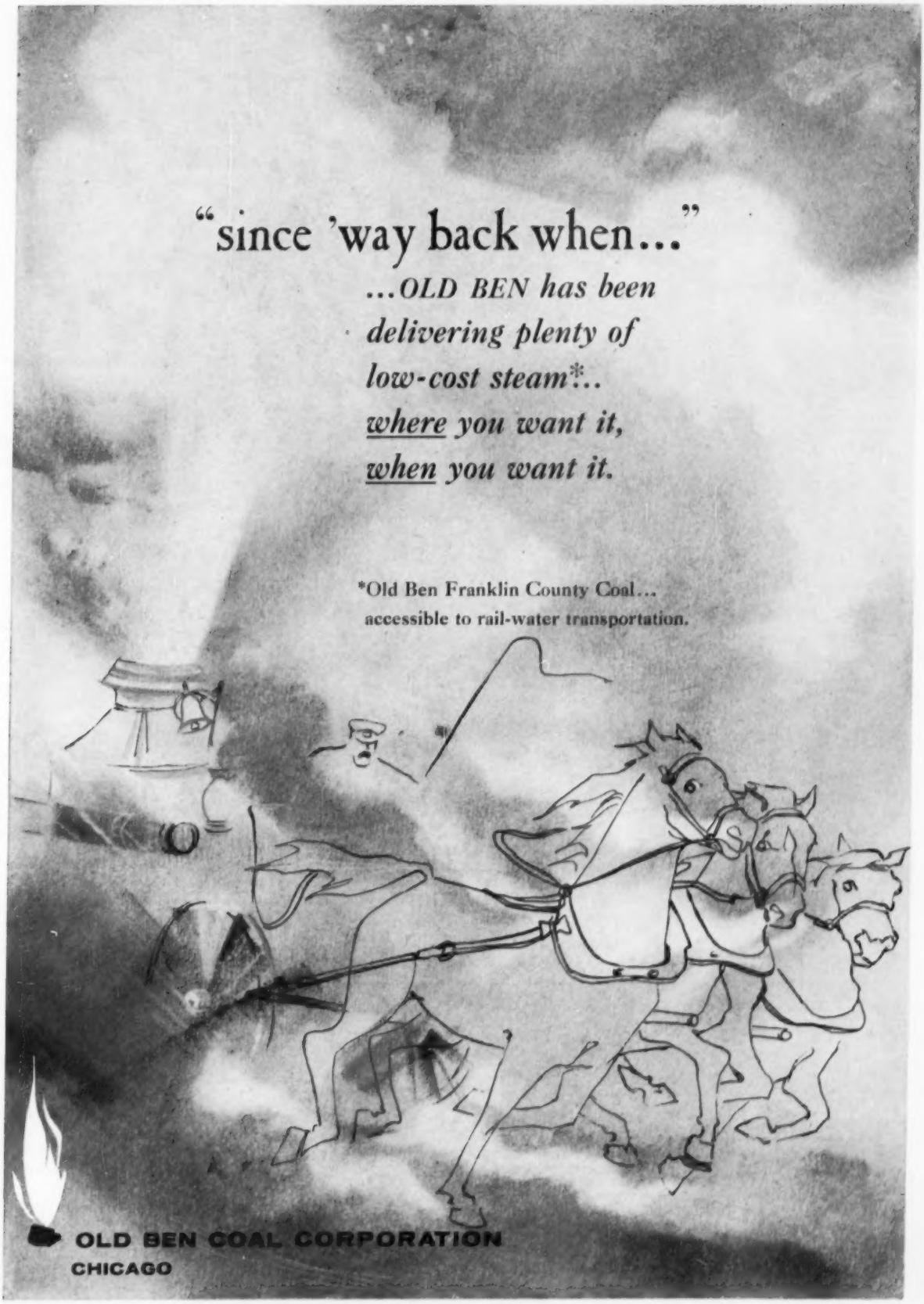
For the 800-ton expansion a demineralizer of 810 gpm average capacity with a peak capacity of 1020 gpm was installed. This demineralizer is operated in conjunction with a 200,000 gal. storage tank which will take care of the excess requirement over capacity, during the time that one of the units is out of service. The cation section of the demineralizer was designed to use sulphuric acid with a charge of 454 lb per regeneration and the anion section to use sodium hydroxide with a charge of 885 lb per regeneration.

Table III is a typical analysis of influent to and effluent from the dimineralizer. This water is checked at frequent intervals during the full day.

The demineralized-water storage tank was lined with protective paint sprayed with enough coats to give a total thickness of 12 mils. Two colors were used in the spraying, these colors being used alternately so as to insure complete coverage of each by observation. This coating was guaranteed for one year to withstand satisfactorily the action of demineralized water at a temperature of 70 to 90 F saturated with oxygen. No tank leaks have developed to date, some four years after installation.

Table III. Typical demineralizer data

Item	Influent	Effluent
Total Dissolved Solids	65	—
Suspended Solids	—	—
Total Hardness as $CaCO_3$	48	Trace
Calcium Harc'ness as $CaCO_3$	44	—
Magnesium Hardness as $CaCO_3$	4	—
Phenolphthalein Alkalinity as $CaCO_3$	—	Trace
Total Alkalinity as $CaCO_3$	28	6
Carbon Dioxide as $CaCO_3$	1	—
Chlorides as NaCel	12	Trace
Sulphate as Na_2SO_4	21	4 plus
Silica as SiO_2	3.0	1.2
Total Iron as Fe	0.2	0.2
Oil	1	—
Extractable Ammonia as NH_3	0.02	—
Copper as Cu_2	Trace	0.2
pH	7.4	8.35
Aluminum as Ael_2O_3	—	0.2



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If you were plagued last winter by calls to "turn up the heat" in your plant, it's time to plan ahead for this year's icy temperatures. Super-Silvertop Steam Traps can increase the efficiency of your steam heating system, and save hundreds of dollars in fuel bills. Whatever type of steam system you have, unit heater, pipe coil, fan system, or any other, you'll find Super-Silvertops will vent the air and drain condensation rapidly, allowing the heater to reach full operating efficiency almost instantly.

Make your steam heating system give you your money's worth. Replace your obsolete traps with Super-Silvertops. Reduce corrosion, get faster heat, save on fuel bills, and enjoy a warm, comfortable plant the year 'round with Anderson Super-Silvertop Steam Traps. See your jobber or Anderson Sales agent today!

ANDERSON
SUPER-SILVERTOP STEAM TRAPS
the Engineered Steam Traps!

THE NEW WAY Notice the simplicity and savings in fittings.

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Free Trap Selector Booklet!

Tells how to select and install traps for all steam equipment. For your free copy, fill out and mail this coupon to:

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NEW ENGINEERING BOOKS

The First One Hundred and Fifty Years, 242 pages, 8 by 10 in., buckram binding. Published by John Wiley and Sons, Inc. 440 Fourth Ave, New York, N. Y., 1957. $7.50.

All engineers and technical men will be interested in this history of John Wiley and Sons because this book is, in effect, the story of progress, not only in industry but also in many areas of the pure, applied, and social sciences.

When Charles Wiley, the founder of the present John Wiley Company, opened up his shop in 1807, the new nation had been in existence only 31 years. It had essentially an agricultural economy but, after the second war with England, manufacturing began to assume more importance. The firm began to publish books to meet the new needs, and it has continued to do so for 150 years.

When it was decided upon to write an authoritative history of the firm, it became clear that because of the diversity of the subject matter covered by the thousands of technical books, no one person could undertake the job. So they turned to their own authors who knew something about the company and the things it tries to do in publishing. The result is very interesting. Each chapter is written by an author who is somewhat of a specialist in the field and who knows something of the history of the technical literature in the respective fields. The book is beautifully printed and bound, and has a number of interesting illustrations.

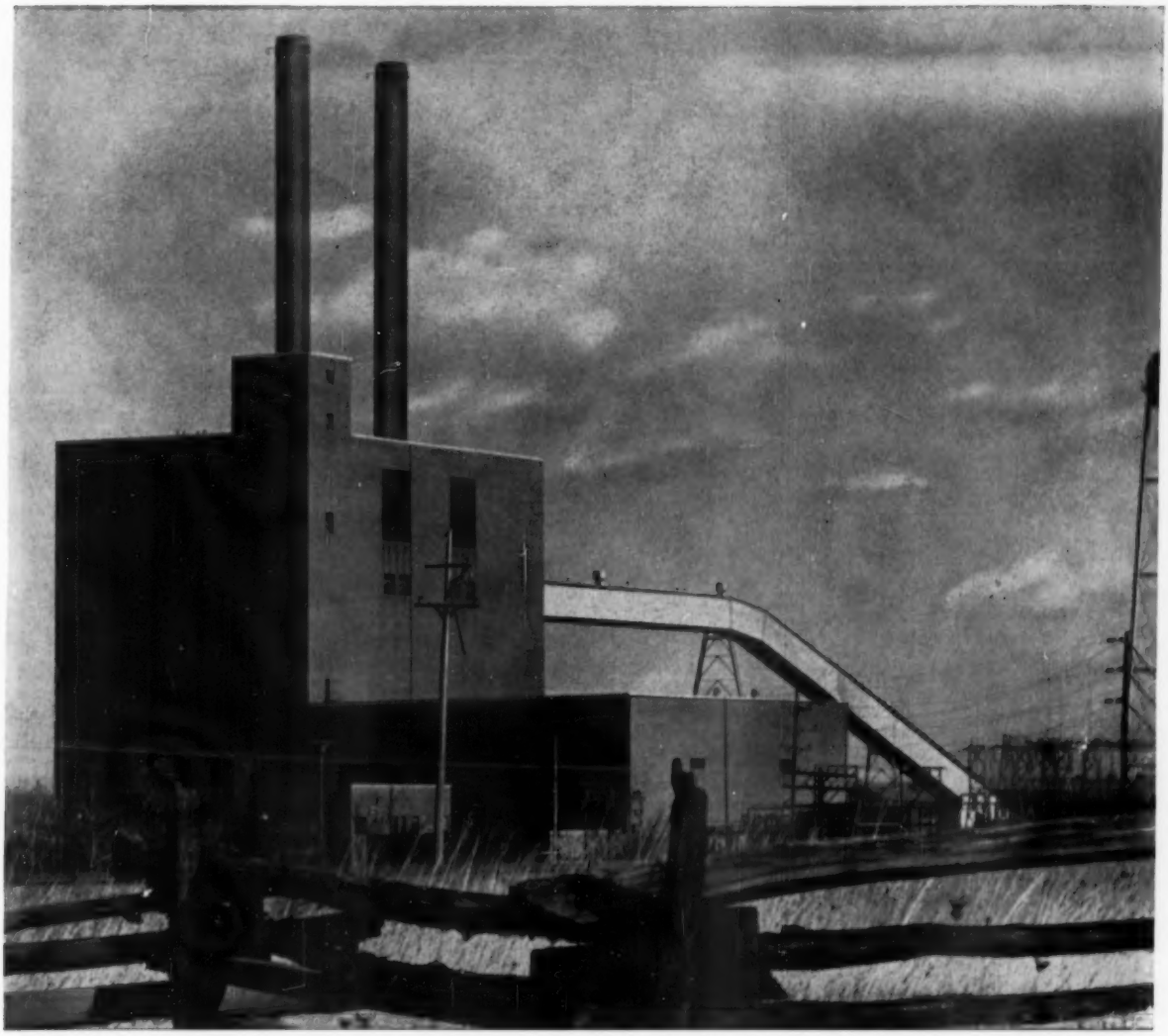
* * *

Power Plants, by Alexander H. Zerban and Edwin P. Nye. Second Edition, 1956. 655 pages, 9 by 6 in., cloth. Published by International Textbook Co, Scranton, Penna. Price $8.50.

The object of this book is to utilize fundamental principles of science in the art of power engineering; to bring to the attention of the student the economic factors that influence engineering decisions; and to give the student a general survey of the equipment of representative manufacturers.

This text is well suited for courses in applied thermodynamics and for the coverage of heat transfer, fuels and combustion, and power generation cycles and equipment. The text is built up around the power plant, which permits portrayal of thermodynamic principles in a real rather than an abstract way.

A chapter on hydro plants has been added since the previous edition. The work on internal combustion plants has been expanded and brought up-to-date. The chapter on power plant economics has been completely revised, and a variety of new prob-



More and more power plant operators are using Lumnite concrete linings in all types of installations from ash hoppers to stack linings—to insure trouble-free service year after year. Above: Ohio Edison Power Company, Niles, Ohio

Solve heat, corrosion, insulation problems fast by using Atlas LUMNITE* cement

- Lumnite-made industrial concretes give rugged resistance against heat, corrosion, abrasion and thermal shock.
- Repairs and downtime are reduced to a minimum.
- Placement is fast and easy — by pouring, plastering or guniting. (For maximum convenience, use Lumnite-made castables. These are pre-mixed, ready for use, and are made by leading manufacturers of refractories.) For more information, write: Universal Atlas, 100 Park Avenue, New York 17, N. Y.

UNIVERSAL ATLAS CEMENTS

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EVERY ENGINEER will want a copy of this NEW BULLETIN

BULLETIN No. 31

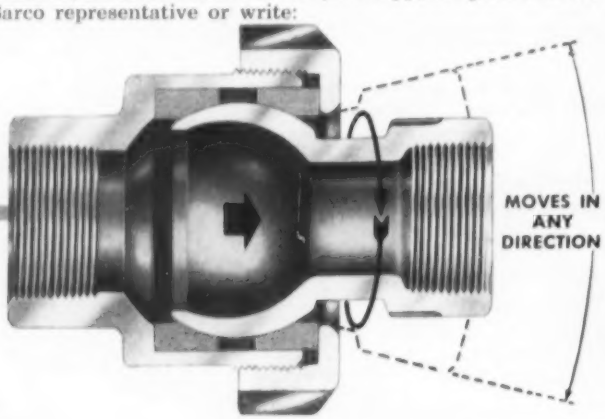
HOW TO SOLVE

PIPE EXPANSION PROBLEMS

CERTAIN distinctive characteristics and features make Barco Flexible Ball Joints particularly well-suited for solving many present-day plant piping design problems, especially for *Steam Service:*

1. **Ability to handle compound movement (where twisting is combined with thermal expansion and contraction).**
2. **Virtually no deterioration. Able to stay in service for years without repairs or maintenance. No lubrication.**
3. **No heavy pipe anchoring required. No "end thrust" developed under pressure. Minimum space needed for installation.**
4. **Maximum safety for high temperature applications. All-metal construction available. Special metals can be specified.**
5. **Basic design is pressure sealing against leakage and self-adjusting for wear.**
6. **Easy to engineer joints into piping to provide for any degree of flexibility, expansion, or movement required.**

New Bulletin No. 31 contains interesting diagrams showing how to solve many common pipe expansion problems EASILY, ECONOMICALLY. *Ask for a copy;* see your nearest Barco representative or write:



FOUNDED 1903 BARCO PRODUCTS BACKED BY EXPERIENCE

BARCO MANUFACTURING CO.
5471 Hough Street • Barrington, Illinois

The Only Truly Complete Line of Flexible Ball, Swivel, Swing and Revolving Joints
In Canada: The Holden Co., Ltd., Montreal

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Engineering Books

continued from page 122

lems has been added for all chapters. The total number of problems now exceeds 500.

In view of the rapidly changing nature of power engineering and the enormous rate of development of the electrical industry, a new chapter entitled "Problems and Possibilities" has been added in which supercritical vapor cycles are discussed and in which the probable role of nuclear power is carefully analyzed and projected.

* * *

Air Pollution Handbook, edited by Paul L. Magill, Francis R. Holden, and Charles Ackley. Size 6 by 9½ in., 720 pages, cloth binding. McGraw-Hill Book Co, Inc, 330 W 42nd St, New York 36, N. Y. Price $15.00.

Everyone concerned with air pollution will find in this handbook all the essential facts and data on Air Pollution. Written by a group of specialists, the book provides a variety of information on different levels, practical as well as theoretical. It explains, for example, how stack height affects deposition of pollutants in an area . . . how to go about getting air samples for testing, or how certain towns are fighting the problem by means of enlightened legislation.

There is information on industrial site location, zoning, and city-planning measures that can prevent serious nuisance problems. Evidence collected by a number of health departments and private investigators is also revealed.

The volume covers hundreds of wide ranging topics such as the permit system of abatement, bag filters, stack design and construction, industrial precipitators, ash contents of fuels, sources of dusts, gas-cleaning separators, sulfur dioxide removal, diagnosing crop damage. A vast amount of tabular data is included, showing the effects of various pollutants.

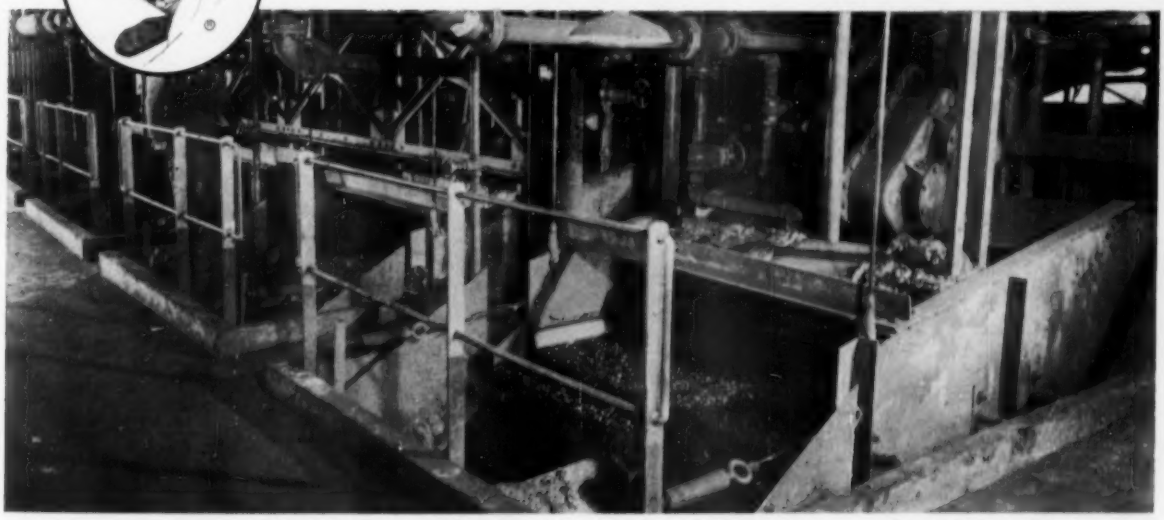
There is also a complete section devoted to reproducing conditions in the laboratory for testing, and the preferred methods of analysis.

* * *

ASTM Standards on Copper and Copper Alloys, 654 pages, heavy paper cover, size 6 by 9 in. Published by American Society for Testing Materials, 1916 Race St, Philadelphia 3, Pa. Price $5.75.

All of the ASTM Standards pertaining to copper and copper alloys, which were developed by ASTM Committee B-5 on Copper and Copper Alloys, Cast and Wrought, and related standards developed by Committees B-1 on Wires for Electrical Conductors and B-2 on Non-Ferrous Metals and Alloys, have been compiled into a compact, handy volume. The December, 1955, edition of ASTM Standards on Copper and Copper Alloys includes in their latest form 127

WHY CHESSIE'S RAILWAY IS FIRST IN COAL



SUPERIOR COAL. Typical of the modern methods employed by producers on the C & O is this battery of screens de-watering washed coal. The naturally superior coals found in the Chessie area can be sized and processed to suit your exact requirements.

SUPERIOR SERVICE. Chesapeake and Ohio Railway is equipped to give you prompt and dependable deliveries through expanded high-speed yards and improved signal systems. There are plenty of good-order cars in the world's largest fleet. A prompt repair program keeps 99% of the C & O cars in constant operation.

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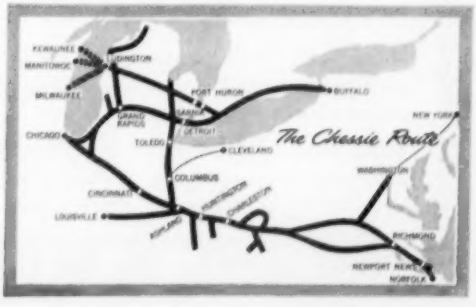
Chesapeake and Ohio Railway

WORLD'S LARGEST CARRIER OF BITUMINOUS COAL



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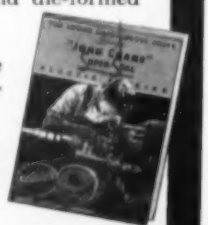
Here is the answer to the plant operator's need for a completely satisfactory packing for temperature conditions up to 550°F. It is the finest sealing packing available. By itself —or in combination with a more dense packing—it is the perfect packing for use throughout the plant in condensate, boiler feed, heater drain, circulating and evaporating pumps.

Super Seal is a combination of non-frictional metal particles and asbestos fiber . . . graphite impregnated and bonded together with special resilient binders to meet specific service conditions. It contains no volatiles. Nothing can be squeezed out or driven off under heat. It will not dry out or harden.

Other types of Super Seal are available for handling acids, alkalis and solvents, also oil, distillates, fruit juices and similar services. Supplied in spirals, coils and die-formed rings to fit all stuffing boxes.



Have "John Crane" engineers recommend the style Super Seal Packing best suited to your service. Request catalog.

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Engineering Books

continued from page 124

ASTM Standards — 110 specifications, 12 test methods, 2 recommended practices, 2 classifications (of coppers and copper-base alloys), and 1 definition of terms.

Standards cover copper, copper-alloy, and copper-covered-steel electrical conductors; copper and copper-alloy plate, sheet, strip, and rolled bar; copper and copper-alloy rod, bar, and shapes, and die forgings; copper and copper-alloy wire; copper and copper-alloy pipe and tube; copper-alloy ingot; copper-alloy castings; copper and copper-alloy filler metal; and methods of test for copper and copper-alloys.

Of the material included in this compilation 50 of the specifications have been revised and a new specification for threadless copper pipe has been added since the previous edition.

* * *

Reactors, edited by R. A. Charpie, D. J. Hughes, D. L. Littler and M. Trocheris. First Edition, 492 pages, 6½ by 9¼ in., cloth. Published by McGraw-Hill Book Co. Inc, 330 W, 42nd St, New York, N. Y., 1956. Price $14.00.

This volume is the second of a series of 8, entitled Progress in Nuclear Science, being published by the McGraw-Hill Book Co. As indicated in a foreword by Dr. L. R. Hafstad, former Director of the AEC's Reactor Division, this volume is the tangible symbol of a historic milestone in the international advance of science. It presents a series of review papers on the present state of the reactor art.

Included are surveys of the design and operating characteristics of the important research reactors throughout the world including the Soviet Union. The summaries by acknowledged experts in the field enables one to compare in detail the state of the nuclear power art in various portions of the world. Every reactor project is represented in this volume and the surveys have been enlarged to include all the information presented at the Geneva Conference.

* * *

Handbook for Small Sawmill Operators, prepared by Logging and Milling Committee of Forest Products Research Society. Size 5½ by 8½ in., 62 pages, paper binding. Published by The American Society of Mechanical Engineers, 29 W 39th St, New York 18, N. Y. Price $3.00.

This new handbook is designed to help operators of small sawmills produce more and better finished lumber from a given quantity of logs. It is divided into four chapters: Machinery, Saws, Mill Setup, Operation and Trouble-Shooting. Each of the chapters contains specific recommendations and suggested

Neodesha packs 1-2 performance punch

1 | *Nordberg Diesels* 2 | *STANODIESEL Oil M*

Operator J. N. Finkinbinder (left) and Everett Powell, Neodesha Superintendent of Electric and Water Plants, adjust rocker arm assembly of Nordberg Duafuel Engine. Engine operated 40,431 hours before overhaul, carrying about 90% of load. All engines in service at Neodesha are Nordberg's. All use Standard Oil's STANODIESEL Oil M.

Finkinbinder and Powell inspect oil filter used for filtering STANODIESEL Oil M used in all six Nordberg Diesels at Neodesha, Kansas, power station.

Quick facts about STANODIESEL OIL M

- Keeps crankcase, pistons, cylinder walls clean.
- Combats deposit and wear problems imposed by using economy fuels.
- Maintains film on difficult to lubricate parts.
- Eliminates spark plug fouling in spark-ignited gas engines and reduces combustion chamber ash and deposits in engines burning natural gas, LPG and liquid fuels.
- Eliminates fuel injector and pump sticking caused by deposits on injector barrel and plunger where fuel and lube oil mix.

The city of Neodesha, Kansas, has six Nordberg engines in service. They have operated more than 400,000 hours on Standard Oil diesel lubricating oils. Here is the case story of one of these engines. The performance of this engine is typical.

In 1952, the city of Neodesha installed a 1,750 hp., 1230 kw., Nordberg Duafuel engine. During the period between February 14, 1952, when the engine went into service, and March 1, 1956, the engine ran 34,370 hours out of a possible 35,784. This is 96% of the engine's total installed hours. In this time, not even a piston or cylinder head was removed. So good was the performance of this engine using STANDARD HD Oil that when Standard introduced an improved diesel oil—STANODIESEL Oil M—in February, 1955, this engine was converted to this new oil.

There is more to the story. The engine continued in service to 36,223 hours when No. 7 cylinder liner was pulled to put rubber gaskets on liner to stop water leakage. At this time, No. 7 piston and liner were checked. Liner wear averaged only 0.0045 inches. The top ring showed an average wear of 0.016 inches. The No. 2 ring was 0.020 inches. Little, if any, wear was indicated on other rings. Now, at 40,431 hours, the engine is down for overhaul of turbocharger and to have valves ground. Bearings were found in excellent condition. No pistons are to be pulled.

Get more facts about STANODIESEL Oil M by calling the Standard Oil office near you in any of the 15 Midwest and Rocky Mountain states. Or write Standard Oil Company, 910 S. Michigan Ave., Chicago 80, Illinois.

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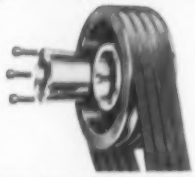

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Engineering Books

continued from page 126

procedures for improving performance in relation to the central theme of the book, "How to attain and maintain accuracy of cutting."

It is noted that a substantial proportion of the lumber produced in America is turned out in small sawmills and that much of this has been found to be inaccurately cut. Although absolutely precise control of thickness is not feasible, the handbook says, a properly maintained mill should be able to produce 96 per cent of its boards within an eighth of an inch of the desired thickness. The new handbook can greatly assist operators in achieving this goal.

* * *

Practical Electrical Wiring, by H. P. Richter. Fifth Edition. Size 5½ by 8¼ in., 602 pages, cloth binding. Published by McGraw-Hill Book Co, 330 W 42nd St, New York 36, N. Y. Price $5.25.

A really worthwhile book for anyone who does, or intends to do electrical wiring of any kind in new or old construction. Here are practical methods explained in plain, easy language. Simple enough for beginners, yet complete enough to be valuable to those already doing electrical work.

Book presents fundamentals, terminology, basic principles, theory behind practices and practical wiring instructions, based all on the 1956 National Electrical Code. In addition to explaining clearly the best methods and approved wiring practices, the book tells why these methods are used. Thus, the reader is prepared to solve both routine and special problems which he will meet on the job.

* * *

The Prospects of Nuclear Power and Technology, by Gerald Wendt. First Edition, 348 pages, cloth. Published by D. Van Nostrand Co, Inc, Princeton, N. J., 1957. Price $6.00.

In this book a distinguished American scientist and editor presents a vital report — international in scope — on the present status of nuclear fission together with a thoughtful appraisal of the future of the industry and society in a nuclear age.

In this book, Dr. Wendt who is now Director of the Institute for Atomic Developments in New York, writes not for the technical expert but for those businessmen, legislators and educators who may expect to participate in the solution of the social and economic problems of the future.

The book is divided into two major parts. Part I gives an overall picture of actual and projected atomic power plants and describes the new problems that they introduce in such realms as finance, insurance and governmental control. This new age promises an industrial, economic, and social revolution far greater than any we have ever known.

Part II, entitled "Technology" covers in detail the mineral resources available, the nuclear fuels needed, the new metals and materials used in the construction of nuclear reactors and the design of the various types of reactors. This section also points up problems remaining to be solved with regard to fission products — their processing, extraction, and disposal.

Not too technical, yet not overpopularized, this book offers a stimulating and realistic survey of the most important new factor in our civilization.

* * *

Electrical Engineering Circuits, by Hugh Hildreth Skilling. First Edition, 724 pages, 6¼ by 9½ in., cloth. John Wiley & Sons, Inc, 440 Fourth Ave, New York, N. Y., 1957. Price $8.75.

This textbook on a-c circuits is intended to accomplish two things. First, it gives the students a strong foundation in the subject by devoting approximately two-thirds of its coverage to traditional topics. Secondly, it offers meaningful discussions of newer concepts, preparing students for advanced courses in electrical networks and system design. By this means of approach Professor Skilling is able to break down the barrier that has existed between elementary circuit courses and the new ideas and language of the more advanced courses.

Among the modern concepts covered are: network theorems; loop and node equations of networks, locus curves and other graphical methods; resonance of high-Q circuits; impedance and admittance functions; poles and zeros in the complex frequency plane: the transform concept; and finally, the Laplace transformation.

The material in this book has been used in preliminary form during several years of teaching and repeatedly revised in response to student reaction. Explanations have been simplified and clarified, and they include many worked-out examples. Graded problems are also supplied at the end of chapters, with the problems keyed to a particular portion of the text and answers to every fourth problem given in the appendix.

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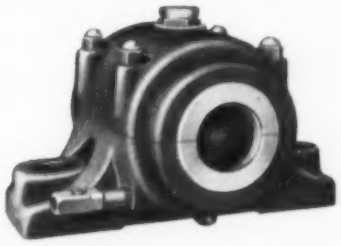

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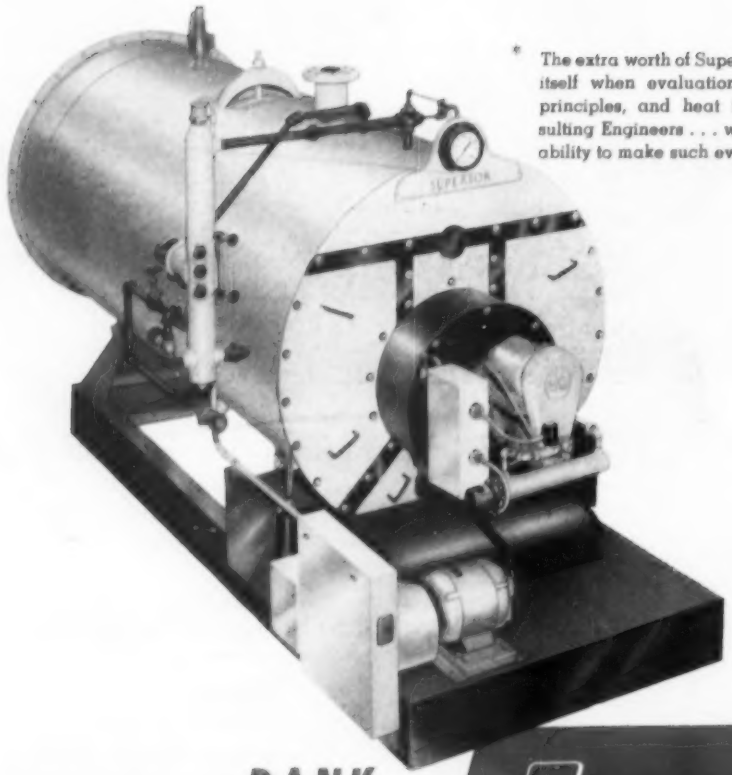

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PUMPS AND PUMPING

201 Controlled Volume Pumps — Bulletin 953, 24 pp, describes and illustrates use of controlled volume pumps in industrial water treating systems. Construction and operation features are described, capacity-pressure ranges and speed and stroke length adjustments are charted. Typical chemical feed and water treating systems are presented through text and diagrams; and an analysis of boiler water treating systems, cooling water treating problems, and systems for waste and sanitary water treatment included. Milton Roy Co.

202 High Pressure Pumps — Eight-pp Catalog HP-1254 describes and illustrates company's Series HP controlled-capacity pumps for pressures to 35,000 psi and capacities to 2000 gph. Selection charts are provided for models with crank arm drive and yoke drive, along with application suggestions. Series HP pumps include some 298 models in three basic pump frame sizes for 2-, 3-, and 4-in. pump strokes. Philadelphia Pump & Machinery Co.

203 Non-Clog Pumps — Bulletin 121MV features Mono-Vane single passage impeller pumps designed for handling heavy settleable solids, long stringy solids, effluent, etc. Both horizontal and vertical types are presented along with specifications. Mono-Vane impeller is described in detail, and various models of the pumps are pictured. Aurora Pump Div., The New York Air Brake Co.

204 Steam Pump Care — Bulletin G-2280 "How to Install and Take Care of Steam Pumps," is a 24-pp booklet containing a step-by-step series of 88 illustrations showing how to increase the service life of all types of steam pumps. It offers 28 tips on proper installation of the pumps, 54 tips on care techniques. Section on installation provides information on suction, packing the pump, starting it, and trouble shooting. Section on maintenance deals with such subjects as steam valves, liquid piston and rod, piston packing, liners. Worthington Corp.

205 For Abusive Pumping Jobs — Catalog 4906, 36 pp, covers centrifugal pumps for wide industrial use and especially adapted to handling ashes, abrasive mixtures, slurries, hot and corrosive liquids. It describes several basic types: a horizontal shaft, single-stage side suction pump; a horizontal shaft, single-stage, rear-entrance automatic priming pump; vertical shaft pumps with standard, overhead and quill bearings for wet pit applications. Nagle Pumps.

PACKINGS, SEALS

206 Packings and Gaskets — Catalog P-100C, 32 pp, covers 95 most popular

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packings and gaskets in company's line, furnishing details of construction, service recommendations and size information. Includes charts showing applications. Packing Div., Raybestos-Manhattan, Inc.

207 Mechanical Packings — Featured in 24-pp Catalog 56 are several recent packing developments including the multi-purpose Bel-Vee V-Ring packings, the long wearing criss-cross Braid packing series, twisted foil packings for oil and distillate temperatures to 1000 F, and an Inconel-wire reinforced plastic packing for valves handling superheated steam at temperatures up to 800 C. Packings for every industrial application are covered and a recommendation chart is included. The Belmont Packing & Rubber Co.

208 Mechanical Seals — Bulletin S-205-2, 8-pp, covers the complete line of chemically inert mechanical seals for handling all types acids, corrosives, solvents and gases. Provides construction, service and application information, installations and engineering details. Crane Packing Co.

LUBRICATION

209 Versatile Industrial Oil — Described in 20-pp Form AD 4078 is an all-purpose oil offering protection for a wide range of industrial equipment, and available in 15 viscosity grades. Discusses six major characteristics of the oil; explains and pictures its use in hydraulic systems, speed reducers, air compressors, electric motors, hydraulic turbines, bearing systems, etc. A chart shows grades available, uses, properties. Standard Oil Co. (Ind.)

210 Bearing Lubrication — Vol. XL, No. 10 of this company's Lubrication magazine provides an excellent 12-pp article on industrial bearing lubrication. Illustrated with photos and drawings, text covers such subjects as bearing design; bearing surfaces; bearing overhaul; aspects of lubrication, including factors involved, in choice of turbine oils and diesel lubricants, and the deleterious effects of moisture; and the life expectancy of bearing lubricants. The Texas Co.

211 Lithium Soap Greases — This product information bulletin details qualities and specifications of company's multi-purpose soap industrial greases. Advantages of multi-purpose grease use — such as prevention of lubricant misapplication, simplified maintenance procedures are discussed. Sinclair Refining Co.

212 Multi-Purpose Grease — This bulletin describes Gargoyle Grease BRB No. 1, intended to provide correct lubrication for practically all normally loaded anti-friction and plain bearings. Tells how it resists leakage, affords protection. Socony Mobil Oil Co., Inc.

MECHANICAL POWER TRANSMISSION

213 V-S Drive Selection Tips — Bulletin 20P50, 44 pp, carries handy multi-color tables for quick and easy selection of variable speed Texrope drives. In addition to providing these tables for A, B, C and D section variable speed drives, booklet includes information on design features, drive principles, horsepower rating tables, speed range table. Allis-Chalmers Mfg. Co.

214 Internally Geared Power — Featuring latest design improvements in gearmotors and embodying 60 multicolor

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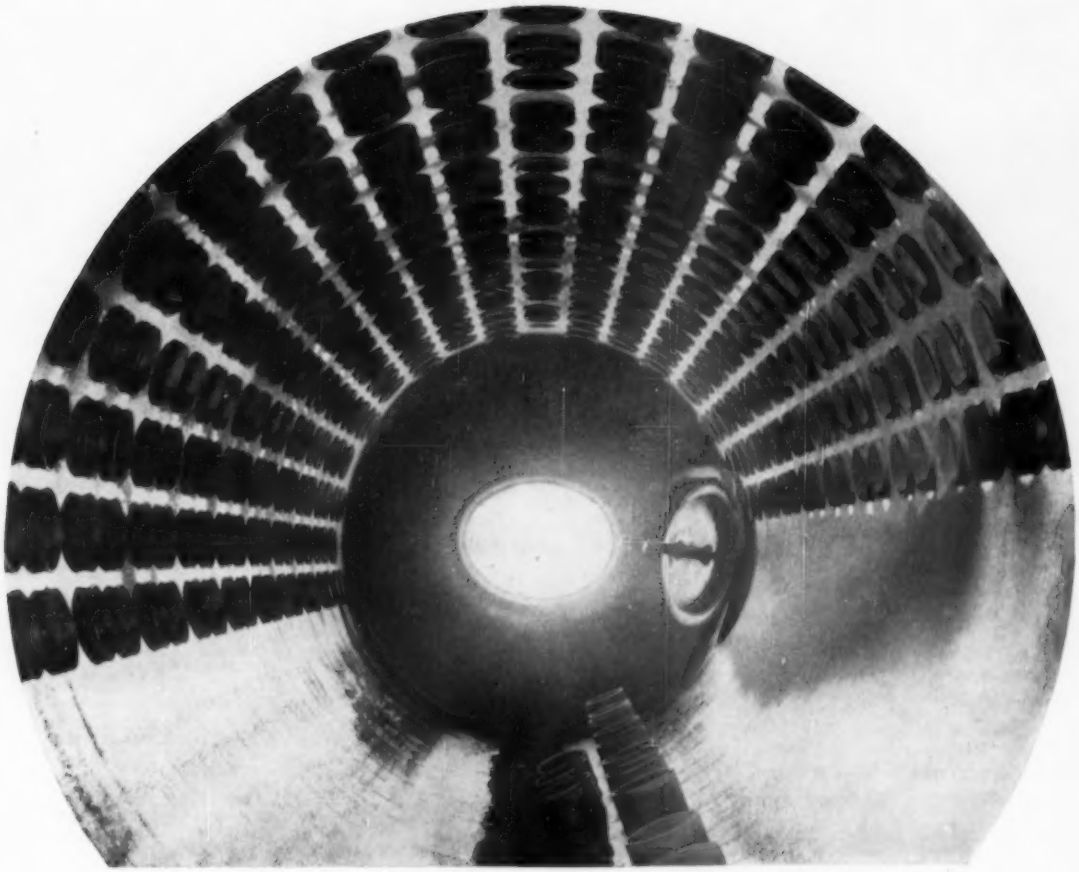

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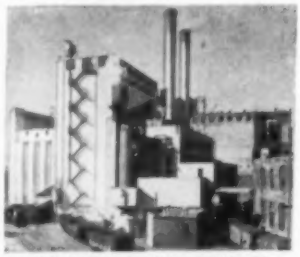

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illustrations, 16-pp Form F-1880 shows comparative advantages of gearmotors, lists ratings from ⅓ to 30 hp with gear ratios as high as 10:1. Cross-sectional details and enlargements of outstanding features are included, as well as a discussion of use of elliptoidal helical gears, and a chart graphing degrees of tempering of gear teeth. U. S. Electrical Motors Inc.

215 Fluid Drives — Bulletins 9419 and 9519 are an illustrated catalog and selection guide on company's new Type VS Class 2 Gyrol fluid drives. Catalog discusses advantages and applications of the drives, covering speed control, power savings, simplified installation, etc. A sectional view shows construction and principle of operation. Dimensions for six sizes of drives are provided. Selection guide consists of tables indicating proper drive to use. American Blower Corp.

216 Spherical Roller Bearing — Eight-pp Bulletin A668 describes design and operation advantages of company's Spher-Align pillow block with improved spherical roller bearing. Complete selection data and specifications are tabulated. Dodge Mfg. Corp.

INSTRUMENTS, CONTROLS

217 Boiler Feed Control — Bulletin 1003, a 12-pp catalog on boiler feed regulators, is illustrated with large application photos and detailed schematic drawings and charts. Relay and direct operation are covered. Case studies of representative boiler loads are presented to show stability of the Flowmatics in controlling feedwater. Copes-Vulcan Div., Blaw-Knox Co.

218 Instruments, Controls — Condensed Catalog 1537 offers brief application information on manufacturer's line of instruments. Fully illustrated, covers draft and pressure instruments, flow meters, liquid levels and pressure gages, CO_2 meters, pneumatic transmitters, positioning operators, temperature instruments, boiler feedwater controls, others. Includes references to detailed literature on each type of equipment. Republic Flow Meters Co.

219 Meters and Controls — Over 100 measuring, transmitting, receiving, recording and indicating instruments and control components, including those introduced within the last year are described in the 8-pp 1957 edition of company's Bulletin G15-1. Applications, ranges, and detailed literature references are given for each product. Bailey Meter Co.

220 Cooling Controls — Bulletin 710B describes company's self-powered cooling controls for compressors, stills, solvent coolers, degreasers, oil coolers, small engines, condensers, others. Includes operational drawing and hook-up sketches. Sarco Co., Inc.

221 Bi-Color Gage — Bulletin 1174 gives advantages of company's Multi-Port bi-color gage made for boiler operating pressures to 3000 psi. Points out chief design features; illustrates construction details through photos and drawings. Diamond Power Specialty Corp.

222 Resistance Temperature Detectors — In 8-pp Publication 3016D are described a line of remote temperature-sensitive elements for use in indicating, recording, controlling and monitoring equipment. Operation, application and construction details of the resistance temperature detectors are presented, along

with specifications and ordering tips. Instrument Div., Thomas A. Edison, Inc.

223 For Feedwater Analysis — Bulletin 148BP contains a technical discussion of manufacturer's analyzers for determination of dissolved oxygen and hydrogen in feedwater. Discusses both O and H units as to function, ranges, accuracy. Cambridge Instrument Co., Inc.

224 Easy Reading Gage — An all-hydrostatic remote reading gage for boiler water and other liquid levels is described in Catalog 500, Section CO. Pictures improved visibility, other advantages offered by this gage, and explains operation. The Reliance Gauge Column Co.

225 Remote Reading Gages — Eight-pp Catalog 291, revised, shows new designs in remote reading liquid level gages, including the Red Flasher Truscale. This has a scale which flashes continuously in red for a positive warning when boiler water level gets too high or too low. Profusely illustrated with photos and engineering drawings, catalog covers gages in four pressure groups from under 900 to over 1500 psi. Jerguson Gage & Valve Co.

226 Pressure Regulators—Form 1011, on flow regulators, provides selection data with photos on three principal types of main valves and pilots. Also illustrated by line drawings are three suggested applications of regulators. A steam capacity table for the selection of main valve size is also shown. Spence Engineering Co., Inc.

ELECTRICAL EQUIPMENT

228 Testing Instruments — Bulletin 19-57, 16 pp, features company's electrical testing instruments, including ohmmeters, ground testers, dielectric test sets, motor rotation tester, cable fault locating equipment, transformer turn ratio test sets, corona test equipment, frequency meters, tachometers, others. Includes photos and descriptions of each type, including chief features, operating ranges, and applications. James G. Biddle Co.

229 On Copper Conductors — Publication C-25, 62 pp, is designed to help make the selection of bus conductors easier. Included in booklet are tables regarding such shapes as channels, ventilated square tubes and round tubes. There are tables for other rigid bus conductor shapes, also data on bare copper wire and cable as well as commonly used alloy wires. Also provided is a general discussion of copper, its physical and electrical properties. Photos illustrate many installations. The American Brass Co.

230 Cable Installation Tips — Publication 19-606 is a 36-pp booklet on installation practices for company's interlocked armor cable systems. Booklet is devoted to photos showing terminations and splices; connections to switchgear, motors and plug-in bus; special installation problems; typical installations; and "before" and "after" illustrations showing the older wiring system side by side with the new interlocked armor cable system. General Electric Co.

231 Selecting Protective Devices — The Protection Handbook, 24 pp, is based on the 1956 National Electrical Code, and interprets this code into easily read form. It covers the selection of protective devices for electric circuits, motors, appliances and apparatus, and includes a list showing the size to use when ordinary fuse,

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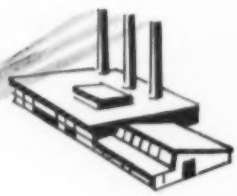

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Fustron dual-element fuse or Fustat is installed. All information is condensed. Fully illustrated, book gives wiring diagrams, motor tables. Bussmann Mfg. Co.

232 High-Power Batteries — Bulletin CP-538/55 covers company's line of Hi-Power batteries for use in the control-switchgear, emergency lighting and auxiliary power fields. Includes data on battery ratings and capacities, details of design and construction, dimensions, weights and types of containers. C & D Batteries, Inc.

233 Cable Troughs — This 12-pp catalog offers a simple solution to any design problem of change of direction or elevation with a complete set of standard fittings, horizontal elbows, inside and outside vertical elbows, ties, crosses, covers and many special fastening devices to save time and labor. Contains full instructions for installations, load charts, accessory items, some typical installations and full list of distributors. The Globe Co.

VALVES, TRAPS, PIPING AND ACCESSORIES

234 Check Valves — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principles of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, sizes. The Chapman Valve Mfg. Co.

235 Water Hammer Control — Cause, effect and control of water hammer in piping systems is the subject of 8-pp Bulletin WH 851. Photos, drawings and curves supplement text, and test data is presented to show efficiency of company's silent check valves in water hammer control. Some typical installations are illustrated. The Williams Gauge Co., Inc.

236 Regulating Valves — Bulletin 5305 describes double seated diaphragm regulating valves for use with control instruments, outlining special features of the valves, particularly the "flow line" contoured-body engineered for high capacity at low pressure drop. Leslie Co.

237 Boiler Blow Off Valves — Bulletin E-125, 24 pp, describes and illustrates the design and construction of company's quick-operating valves, angle valves, Y valves and duplex units specifically designed for boiler blow-off service. Includes dimensions. Everlasting Valve Co.

238 Lubricated Plug Valves — Catalog PV-24, 36-pp, shows in detail a line of iron and steel lubricated plug valves. Many illustrations of the single, screwed and bolted gland type valves are shown, including photos, sectional and detailed drawings. Also included is physical data on dimensions. The Wm. Powell Co.

239 Valve Chart — Form 194R, 22 pp, is a valve comparison chart, listing valve figure numbers of 15 major manufacturers and the OIC equivalent valve figure numbers. Compares variety of valves in ferrous and non-ferrous materials, describes different valve lines. The Ohio, Injector Co.

240 Valve Charts — Now available to power engineers are three well-organized wall charts on valve types, selection and protection. "How to know valves" covers four main types of valves from the standpoints of their appearance, inside con-

struction, service intended, operation and use. "How to select valves" discusses five major factors involved in the choice of a valve — fluid, temperature, pressure, size and function. "How to protect valves" — written in "do and don't" style covers 11 important points in valve installation, operation and maintenance. R-P & C Valve Div., American Chain & Cable Co., Inc.

241 Bronze and Steel Valves — Catalog 200, 80 pp, describes company's bronze and steel valves, including globe, angle, gate, Flocontrol and other types applicable to power, petroleum, chemical and general industry installations. Engineering data such as material specifications, flow charts, temperature and pressure ratings are included. The catalog is profusely illustrated with photos, cutaway views and dimensional drawings. Manning, Maxwell & Moore, Inc.

242 Air Release Valves — Bulletin 856 covers air release valves for venting air from hot water heating systems, venting air from chilled water cooling and air conditioning systems, and releasing air from industrial and municipal pipelines and other equipment as water mains, water filters, tanks, brine lines, etc. Describes operation, lists features, and gives specifications and capacities, as well as typical installation drawings. The V. D. Anderson Co.

243 Industrial Valves—Bulletin 507V illustrates and describes company's line of industrial valves for control of air, gas, liquids and solids. Features photos and descriptive detail on a variety of valves, including butterfly valves, wafer butterfly valves, treaded butterfly valves, slide valves, check valves, proportioning valves and others. W. S. Rockwell Co.

244 Choosing the Right Valve — Presenting valve selection as a matter of matching the valve's service characteristics with service requirements of the job, this practical 20-pp booklet explains and illustrates basic design features of gate, globe and check valves. It tells, in nontechnical language, how each of these valve types works, and where it is suited for use. Disc, stem connection, bonnet and bonnet-joint characteristics are discussed and illustrated. Crane Co.

245 Trap Service Guide — To promote better trapping practice, pocket-size 32-pp Bulletin 7511 offers practical tips on installation, testing, and maintenance. Chapters are devoted to inspection and repair, trouble shooting, parts identification. Capacity charts are provided, also tables showing interchangeability of company's trap parts. Other sections deal with strainers, check valves, automatic trap drains. Armstrong Machine Works.

246 Steam Trap Selector — Twelve pp Bulletin T-9 is designed specifically to aid in selection and application of steam traps on chemical processing equipment. Features a foldout piping diagram for 22 pieces of typical processing equipment — each showing recommended steam trap and piping arrangements. Also contains selector tables. Yarnall-Waring Co.

247 Flexible Ball Joint — Catalog 215-B, 20-pp, describes advantages of company's flexible ball joints for use in piping for power, process, heating, chemical, construction, or hydraulic service. Includes engineering specifications and data on the standard 300 lb series and the series 600. Screwed, flanged and welding end joints are listed, as are insulating

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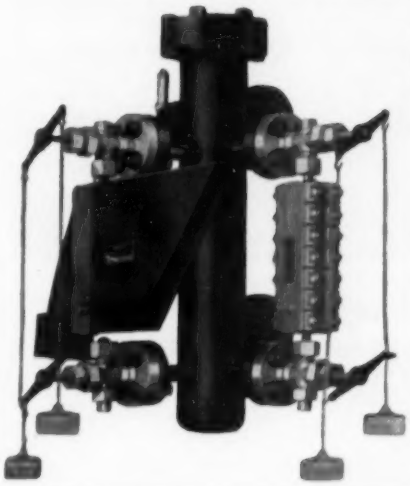

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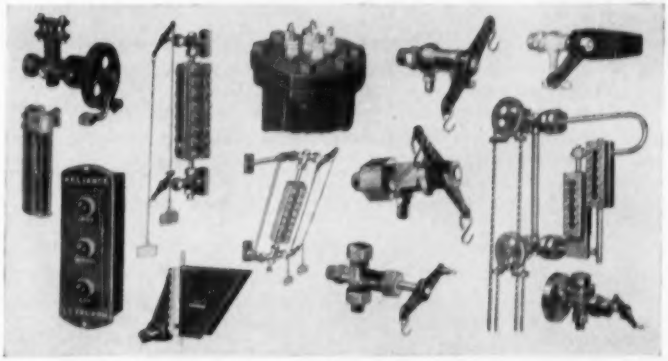

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joints and jacketed joints for handling asphalt and other liquids that solidify unless heated. Barco Mfg Co.

BOILERS, GENERATORS

248 Water Tube Boilers — This 12-pp catalog describes packaged water tube boilers, in capacities from 8000 to 50,000 lb per hour. Interesting as well as informative, this booklet uses color and illustrations to amplify text. Gives complete data and dimensions for boilers designed for firing oil or gas or both. Superior Combustion Industries, Inc.

249 Shop Assembled Boiler — Sixteen-pp Bulletin G-76 completely describes and illustrates company's Type FM water-tube integral-furnace boiler, made in standard sizes from 2000 to 28,000 lb of steam per hr, pressure to 250 psi. The Babcock & Wilcox Co.

250 Hot Water Boilers — This 20-pp brochure describes and illustrates design, construction, advantages and economies of the C-E La Mont controlled circulation hot water boiler for supplying high pressure, high temperature water for heating systems and process applications. Combustion Engineering, Inc.

251 Automatic Boilers — Bulletin BE-4 describes operation and advantages of Continental automatic boiler's spinning gas technique — a method of obtaining maximum heat transfer with a simplified design. Shows cutaway view of boiler construction; illustrates hinged doors and method of injecting air. Boiler Engineering & Supply Co., Inc.

252 Steam Generators — Illustrated Bulletin SB43, 20 pp, describes company's VL factory assembled generators combining 2-drum water-type boiler, integral water cooled furnace, brick work, insulation and steel casing. A large cutaway illustration shows design details, and gas travel. Erie City Iron Works.

253 Steam Generators—Bulletin 55-1, 22-pp, describes company's products and services, including not only steam generators but also custom metal fabrication. There are many photos of boilers in various stages of assembly. Engineering drawings of boilers producing up to 500,000 lb of steam per hr on standard fuels are included, as well as illustrations of units for waste heat application and those designed to utilize refuse for fuels — wood chips, coffee grounds. The Wickes Boiler Co.

254 Improved Steam Generator — Bulletin 2000, 28 pp, explains advance design features that distinguish this manufacturer's generator from other unit steam generators. Describes and illustrates engineering differences of component features. Also shows how these components are constructed, assembled and tested. Another section gives data and dimensions for the units. Preferred Utilities Mfg. Corp.

255 Standard Generators — Bulletin B-55-4 describes company's SC economy series of standard steam generators designed to reduce steam costs for industrial plants. Pre-engineered, standardized steam generators offered in nine sizes, with capacities of from 50,000 to 150,000 lb per hour are described, and schematic and cutaway drawings of design features are included. Foster Wheeler Corp.

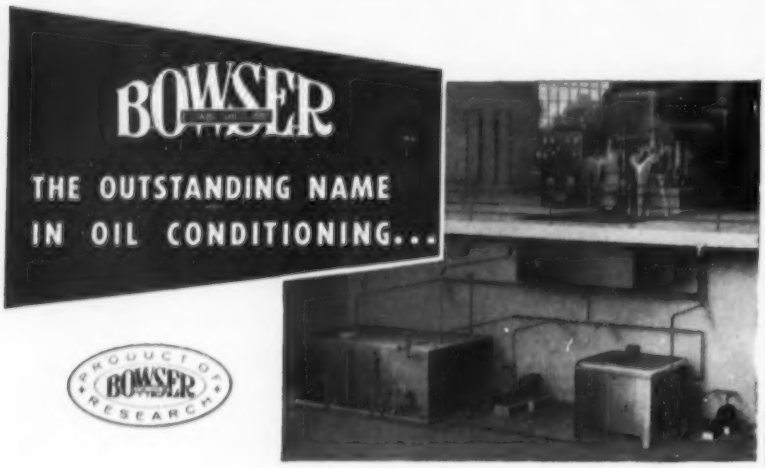
256 Packaged Generators — Bulletin MH 3-54, 14-pp, gives detailed coverage to company's Type MH packaged water tube steam generators which are furnished for oil or gas firing or both, with automatic, semi-automatic, or manual controls. Included are: cutaway illustrations, installation photos, tube arrangement layouts, construction details, auxiliary equipment, dimensions. Union Iron Works.

FUEL BURNING EQUIPMENT

257 For Burning Refuse Fuel — This 8-pp bulletin describes refuse fuel burning equipment, including a pneumatic refuse fuel distributor which spreads refuse fuels such as bark, wood chips, and bagasse uniformly over the grate surface. Discusses construction features of various components. Riley Stoker Corp.

Postage-free cards for ordering catalogs are on page 131. You may also use the cards to order literature mentioned in the ads.

258 Steam Atomizing Oil Burners — Sixteen-pp illustrated Bulletin 21 describes steam atomizing oil burners and auxiliary equipment for use with heavy oil or tar in boilers, stills, dryers and other furnaces where steam or compressed air is available for atomizing the oil. Includes information on furnace design and construction. National Airoil Burner Co., Inc.



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259 Oil and Gas Burners — Bulletin OB-53, 28 pp, gives principles of selection and application of oil or gas burners, or a combination of both for standard and wide capacity range operation, together with air registers and fuel oil heating and pumping sets. Conversion table shows approximate relationships between quantity of oil burned, boiler capacity and air required for combustion. The Engineer Co.

REFRACTORIES, INSULATIONS

260 Refractory Cement — Heavy duty brick bonding and patching mortar is described in this 8-pp illustrated color folder. Includes success stories concerning the product's application in high temperature work and in the protection of equipment against slag, fly ash and gases. Refractory and Insulation Corp.

261 Refractory Concrete — Basic information on recommended practice for mixing and placing refractory concrete, used in the metal, power, ceramic, and petroleum refining industry as a material to withstand service temp to 2600 F or more, is presented in this 16-pp manual. Sections are devoted to special properties of refractory concrete, aggregates, refractory insulating concrete, and structural design. Universal Atlas Cement Co.

262 Refractory Castable — Bulletin R-40 describes use of Kaocrete-32, a high temperature refractory castable, in boiler ashpits. A discussion of various methods of ash removal, along with maintenance problems peculiar to each, is presented. Four typical installations are detailed. Refractories Div., The Babcock & Wilcox Co.

263 Duct Insulation — Engineering data and application instructions for company's semi-rigid, spun mineral wool duct insulation are presented in this informative bulletin. Thermal and sound absorption characteristics are presented in tabular form and physical, chemical, mechanical properties given. Baldwin-Hill Co.

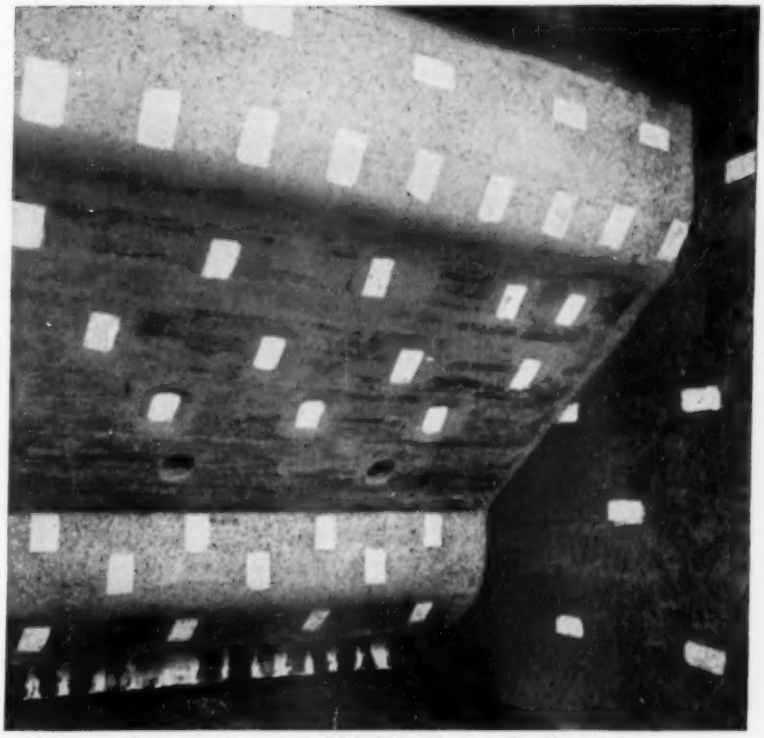
264 Underground Pipe Insulation — This illustrated bulletin discusses the problems of underground pipe insulation and explains how company's insulation for hot underground pipes overcomes them. On-the-job photos illustrate ease of application; brief technical data are also included. American Gilsonite Co.

TUBING AND ACCESSORIES

265 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads. Roto Div., Elliott Co.

266 Heat Exchanger Tubing — Cited in this 30-pp catalog are typical cases where cupro-nickel or Monel tubing installed in heat exchangers resulted in substantial savings and better efficiency through longer tube life. Describes applications of this tubing in various instances where unusual water conditions, as to pollution, excessive turbulence, temperature and the like, required such tubing. The International Nickel Co., Inc.

267 Tube Expanders — Catalog 88, 119-pp, is full of detailed information about tube expanders and associated tools used for tube rolling. Profusely illustrated, catalog provides information relative to boilers, condensers, evaporators or miscellaneous heat exchangers. Special sections



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Laclede Super Plastic Refractory Helps Cudahy save $250,000

Here's how Cudahy Brothers Company saved the cost of a new boiler. Engineers rejuvenated an old 607 hp., 4 drum boiler by opening its bottled-up furnace and designing a new arch. The new furnace walls and arch —of Laclede Super Plastic Fire Brick—increased furnace volume by over one-third.

Output soared from 37,000 lbs. of steam to 50,000 lbs. hourly. The old boiler now operates at 150% to 175% of rated capacity, and works continuously except for short cleaning periods. Formerly, low efficiency and high refractory maintenance limited operation to six weeks a year. Now it competes with Cudahy's newest steam generator. Maintenance was zero for the first three years and has been negligible since then.

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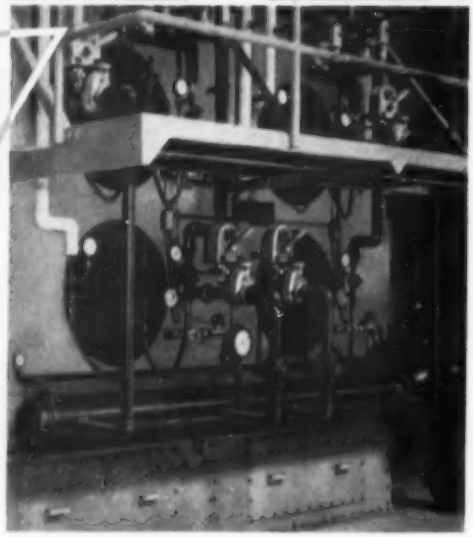

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are devoted to expanders, accessories, measuring instruments, rollers, extensions and drives. Each type of equipment is fully described, applications are listed, and tables of engineering data included. Also covers tube expansion methods, tool maintenance, expansion calculations and charts giving sizes. Thomas C. Wilson, Inc.

COAL, ASH HANDLING

268 Water-Cooled Stoker — Design and operating advantages of the Vibragrate Stoker are outlined in this illustrated bulletin. A large cutaway view details component parts of the stoker and explains operating features. Other drawings show installations. American Engineering Co.

269 Improved Crushers—Bulletin 12-C, 16-pp, describes company's line of crushers for reducing coal, coke, glass cullet, gypsum, lime, metal turning, sugar, sulphur and similar lump materials. Covers Knittel ring type crushers, two-stage double-roll crushers, single-roll crushers, and double-roll crushers. Photos, dimensional drawings and full specifications are included. Stephens-Adamson Mfg. Co.

271 Tractor Shovel — This 8-pp bulletin deals with construction and application of company's HD-11G tractor shovel, a 2¼-yd capacity unit with several work-speeding features. Transmission, hydraulic system, shovel assembly and other components are described in detail. Specifications included. Allis-Chalmers Mfg. Co.

272 Why Liquid Diffusion — What liquid diffusion can do for power plants is explained in Form B, which tells how liquid diffusion compounds work and gives four practical applications. These include dust control in coal handling, fly-ash control, coal storage pile treatment and boiler cleaning. Johnson-March Corp.

WATER CONDITIONING

273 For Boiler Protection — Scav-Ox, a 35 per cent hydrazine solution for removing dissolved oxygen from boiler feedwater, is described in this 16-pp illustrated booklet. It covers in detail the use of the solution for protecting low, medium and high pressure boilers, discussing determination of dosage, recommended methods of application, testing methods for hydrazine, and properties and handling of the material. Comprehensive operating data given. Olin Mathieson Chemical Corp.

274 Feedwater Treatment — Process Bulletin B1, "Treatment of Boiler Feedwater by Direct, or Internal Method," discusses advantages of direct treatment, as a complete treating program or as a supplement to external systems. Explains why direct treatment is convenient, economical. National Aluminate Corp.

275 Steam System Treatment — This bulletin on Coravol for prevention of corrosion explains theory of corrosion, application of organic amines to steam systems (Coravol process) and presents case histories of use in different types of plants and industries. Coravol is part of a complete technical service providing chemical formulas for treatment of water, steam, brine, fuel. Western Chemical Co.

276 Evaluating Steam Purity — Technical Paper 135, 8 pp, entitled "Conductivity vs Sodium by Flame Spectro-

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Two Nagle 4" type "T" pumps, in a two stage installation, are ably handling 600 GPM of fly ash slurry against 400 ft. of head, at Windsor plant of Beech Bottom Power Co., Power, W. Va. Water-end parts are of abrasion resistant ABK Ni-Hard nickel iron alloy.

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photometer In Steam-Purity Studies," presents results of laboratory and plant work to indicate that sodium is extremely valuable in evaluating steam purity. Performance curves are included in the paper. Betz Laboratories, Inc.

277 Water Treatment — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pretreatment, internal treatment, treatment application, blow-down adjustment, test control. Dearborn Chemical Co.

278 Feed Water Deoxygenation — The advantages of chemical deoxygenation of boiler feed water with an aqueous solution of hydrazine are described in 12-pp Bulletin BW 5. How hydrazine serves to maintain boiler in cleanest possible condition, reducing iron oxide scale to a magnetic oxide, is fully detailed, and such considerations as economy and operation, handling precautions, storage are covered. Fairmount Chemical Co., Inc.

279 Mixed-Bed De-Ionizers — Practical equipment for mixed-bed de-ionization at flow rates of 5 gph to 5000 gpm is described in this 8-pp bulletin. Advantages of construction and design are detailed, as well as mechanical features, installation operation. Illinois Water Treatment Co.

280 On Demineralization — Technical Reprint T-140, 23-pp, a profusely illustrated article on demineralization, discusses advantages and disadvantages of this process for today's power plants. Developments, trends and applications of both multi-bed and mixed-bed ion ex-

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All you need to do is circle the item numbers of those you want. Then fill in your name, job title, company name and address—and mail the card.

You may also use the Reader Service Cards to request information on products described, or literature mentioned in the ads—just circle the number below the ad.

change are considered, and several case histories cited. A comprehensive bibliography lists 119 separate items. Tables, flow sheets, descriptive drawings, performance curves, process selection charts included. Graver Water Conditioning Co.

281 Valveless Filter — Operation of company's automatic valveless filter is described in this 8-pp illustrated bulletin. Applications and typical operating conditions are detailed and diagrams and photos are included. The Permutit Co.

OTHER EQUIPMENT

284 Metal Laminates — Types of metal laminates, metals which can be laminated, and use in heat exchangers, electronics and other applications are detailed in this illustrated 8-pp bulletin. Advantages and properties are described, and size data given. Bridgeport Brass Co.

285 Product Guide — Manufacturing facilities for company's line of steam turbines, turbine generators, ship propulsion units, feed pumps, centrifugal compressors, blowers, centrifugal pumps, reduction gear, and other products are described in this profusely illustrated 50-pp catalog. Photos show manufacturing procedure. De Laval Steam Turbine Co.

287 Turbine Speed Control — Thirty-pp wire-bound Bulletin H-21 is titled "Fundamentals of Turbine Speed Control." It is an elaborately illustrated, educational booklet intended to clarify operation of common types of automatic speed control for steam turbines. An introductory section covers general fundamentals of automatic control systems, and includes a key to control terminology. Simplified diagrams show operating principles of actual control systems. Elliott Co.

288 Equipment For Process Industries — Eight-pp Bulletin G-3 describes company's line of equipment for the process industries, including a conveying system for bulk materials, the Airveyor — a pneumatic conveying system, — the Airslide for transporting fine, dry materials without use of moving parts, as well as compressors and pumps, coolers and preheaters. Photos, cutaway drawings, and performance details are included. Fuller Co.

290 Steam Turbines — The advantages of company's solid wheel turbines, axial flow turbines, single stage and multistage, are outlined in illustrated Bulletin S-140. Describes various models in their line and includes application photos. The Terry Steam Turbine Co.

291 Technical Refrigeration — Twelve-pp Bulletin 754 covers a complete line of environmental testing and processing equipment. Provides illustrations and specifications on recently redesigned altitude, humidity, low temperature and prefabricated test chambers as well as specialized testing equipment. Includes helpful engineering data. Bowser, Inc.

292 Corrosion Control — Treatment of industrial equipment to control corrosion cannot be a hit-and-miss proposition cautions this 6-pp folder. Examples are given of optimum control measures that may avoid costly, unsound treatment procedures, including minor physical or operating changes. Hall Laboratories, Inc.

293 Guide to Corrosion Prevention — How Bitumastic protective coatings aid

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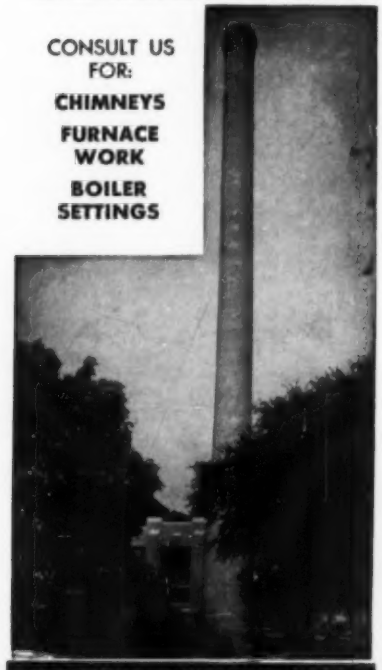

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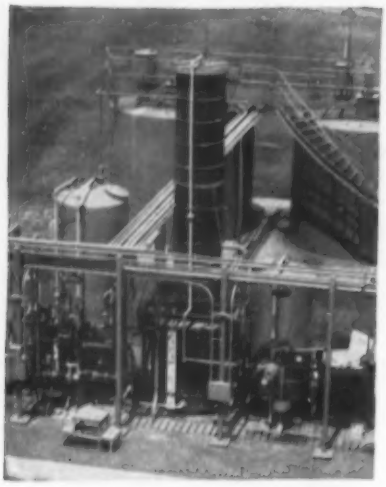

"SILICA: 0.003 PPM, OTHER SOLIDS UNMEASURABLE..."

With some doubt as to the outcome, the de-ionization units pictured above were installed outdoors at a Texas power and light company, to replace evaporation equipment as a means of purifying feed water for a high-pressure boiler. After three years, results far exceeded guarantee and expectations. From raw water containing 27 ppm of silica and dissolved solids totaling 365 ppm, the quality of the effluent is reported as: "Silica, zero to 0.005 ppm, average 0.003 ppm. Other solids are unmeasurable."—This is a good example of what modern ILLCO-WAY ionXchange can accomplish.

BOILER FEED WATER FOR POWER PLANT

The particular plant shown above consists of a cation exchanger, an aerator, and a mixed-bed deionizer. The large tanks in the background hold a supply of regenerants. Operation is manual throughout, a preference of the purchaser. *Results have proved even more economical than expected.*

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in fight against corrosion is told in this 12-pp booklet. Discusses corrosion as a universal industrial problem, role of protective coatings in cutting costs and lengthening service life of structures and equipment, and gives data on several coal-tar-based coatings intended to solve a variety of corrosion problems. Twelve typical case histories covering use of these coatings in varied industries described. Koppers Co., Inc.

294 On Coal Burning Plants — Presented in this illustrated 20-pp booklet, "More and more firms are burning coal the modern way . . ." are eight case histories of notable coal burning plants. They include industrial, commercial and institution power plants, both modernization and new construction. Economy and other advantages of coal as a fuel are stressed. Bituminous Coal Institute.

295 Refrigeration Condensers — Engineering data on a complete range of sizes and types of refrigeration condensers are featured in 38-pp Bulletin RC-2. Ratings in tons refrigeration are tabulated for large and small ammonia condensers, vertical ammonia condensers, ammonia condenser-towers, freon condensers and freon condenser-towers. Selection data, dimensions, dimensional diagrams and tables of pipe sizes given. Henry Vogt Machine Co.

296 Sheet and Plate Fabrication — Illustrated in 40-pp Bulletin F-3 are products of this manufacturer, and equipment used to produce special sheet steel and alloy parts. Shows control panels, switch gear housings, cubicles and other electrical enclosures, boiler air ducts, smoke breechings, tanks. The Kirk & Blum Mfg. Co.

297 Precipitation Products — Twelve-pp Bulletin G106 contains helpful information on company's various precipitation products, including electrical precipitators, multiclone mechanical dust collectors, combination multiclone-precipitator units, Dualaire filter-type dust collectors and Holo-Flite processors. Also illustrates a number of typical installations. Western Precipitation Corp.

298 Engineering For Atomic Power — How $100 million in coin silver weighing 14,000 tons were borrowed from the U. S. Treasurer for use as electrical conductors at the atomic energy plant in Oak Ridge, during the war when copper was scarce, is told in this 36-pp illustrated booklet. Describes the firm's role in the development of atomic energy and outlines its activities in peacetime applications of nuclear power. Stone & Webster Engineering Corp.

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What's New In Design For Big Bergen Station

AS WELL-INFORMED observers of the power field will remember, construction on Public Service Electric & Gas Co's new Bergen Generating Station in Ridgefield, N. J., was begun in the summer of 1956 by United Engineers & Constructors, Inc. Excavation and foundation are now completed and the steel erection is well under way. Expected to be in operation by the fall of 1958, Bergen is a giant costing about $107,000,000, and will have two 290,000-kw units. A number of design innovations have been announced.

The turbine generators at Bergen are the prototype of a new concept in the design of cross-compound machines sponsored by the company's electrical engineering department and developed by Westinghouse. What makes it attractive is the fact that both elements of each cross-compound machine are exact duplicates in all respects except that one shaft has the high pressure steam cylinder and the other has the intermediate pressure steam cylinder. The 3600-rpm low pressure cylinders and the generators are duplicates.

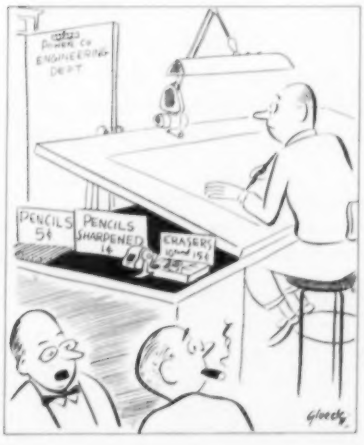
This means that the first two Bergen units will have a total of four identical electric generators and four identical low pressure turbines, an arrangement which lends itself to compactness and a saving in first cost.

The fact that each unit has two 3600-rpm spindles makes it possible to drive the boiler feed pumps directly from the generator shafts, an arrangement that also saves in first cost, and improves operating economy and dependability. Bergen will be the first generating station in the Public Service system to drive the feed pumps in this manner.

Throttle steam conditions at Bergen will be 2350 psig and 1100 F, with reheating to 1050 F. In respect to heat rate (efficiency), the units will be about the same as the recently installed 200,000-kw No. 7 unit at Burlington Generating Station. That rate was 9000 Btu per kwh, as reported in POWER ENGINEERING, June 1956.

During the early years of its life, Bergen Station will burn as much as 4000 tons of coal each day. In terms of 50-ton coal cars, this is an 80-car trainload each day. Yearly consumption of coal has been estimated at more than a million tons. The entire electrical output of the station will be transmitted to Bergen Switching Station at 132 kv.

Instead of taking the cooling water from Overpeck Creek and then returning it warm to the same general location, as originally planned, the discharge from Bergen will now be sent west to the Hackensack River, with more than a mile of waterway between the points of intake and discharge. The solution of this engineering problem resulted in an improvement in the cooling water capacity of the site over the conventional arrangement.



"He never comes right out and asks for a raise—"

pd

"Why Not Play Safe And Buy Your STACK As You Buy Your Car?"

"Joe, you wouldn't buy the engine of your car from one manufacturer, the wheels from another and the body from still another, would you? Neither would I. And when I design for induced draft, I specify a P-D Stack because the I.D. Fan, though it is important, isn't the whole story. The combined breeching, stack and fan, built as ONE apparatus, gives me unit responsibility, compact design, simplified engineering, and positive performance, with a lot less purchasing details.

"Another thing, I'd rather buy my Dust Collector from the same manufacturer that made my Stack and Fan. For this is all part of the same system for handling the gas after it leaves my boiler unit.

"There's nothing like putting all the responsibility on ONE manufacturer's shoulders if you can, for then you'll come out on the long end nine times out of ten. Buying such equipment piece-meal is antiquated and costly."

You can save a lot of time, trouble and money by purchasing your Stack and Dust Collector from Prat-Daniel.

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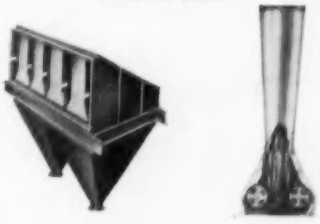

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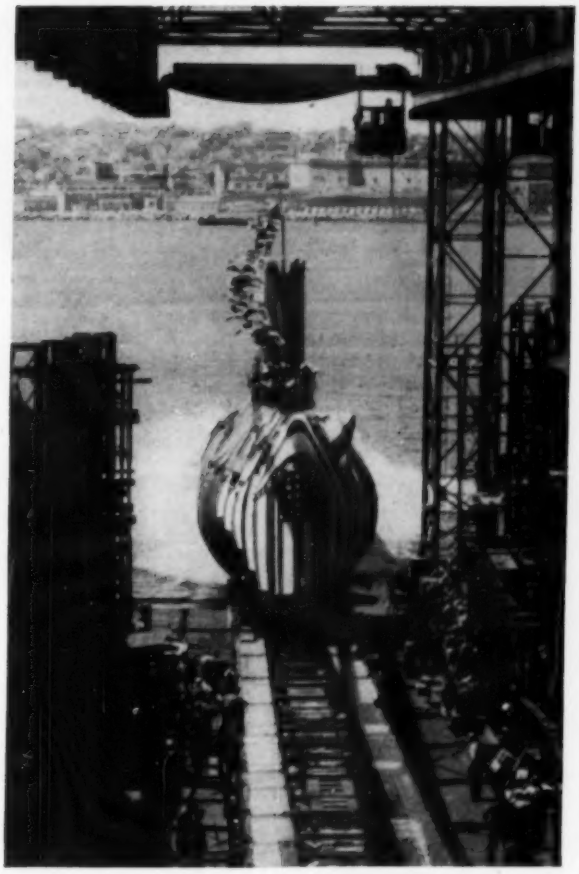

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The Navy's First Production Nuclear-Powered Submarine

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more motor than ever before

more LIFE
Uniclosed is most compact. Same horsepower is provided in a smaller package. An actual saving in space of 46% for the 2 h.p. size.

more RUGGED
Cast-iron frame defies distortion. The smooth cast-iron surface is highly corrosion-resistant. Heavy solid feet are a substantial part of the frame.

more PROTECTION
Ventrifoil directs air, deflects water. Each end of motor has specially formed deflector that directs air around bearing housings, into fans on rotor.

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U. S. UNICLOSED

More motor dependability is the result of more and more exclusive features: Asbestos insulation against heat and moisture; Lubriflush bearing construction for longer life; Ventrifoil baffles to direct air, deflect moisture; rugged, normalized cast iron frame . . . all Uniclosed Type H features for longer motor life, more efficient power. Write for profusely illustrated multi-color Uniclosed Bulletin No. F-1856 today!

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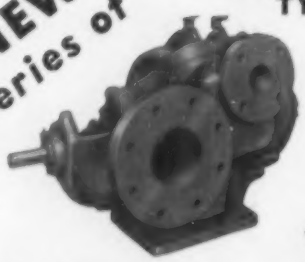
here's an ANGLE 45° that generously PAYS OFF

A NEW series of AURORA® TYPE A



two stage diagonally split case centrifugal

MULTI-PURPOSE PUMPS

You will find that the diagonally split case offers substantial new advantages while retaining all of the best features of the horizontally split case pumps — in that the entire rotating element can be removed without disturbing piping — or — disturbing the pump-motor-base alignment. CONSIDER —

these PLUS BENEFITS

Suited to many applications, importantly BOILER FEED SERVICE as well as hot or volatile liquids duties.

•

Low NPSH Characteristics

•

Being self-venting they WILL NOT VAPOR LOCK

•

45° split allows both suction and discharge to be in the bottom half of casing but above the center line of the pump.

Aurora Type AJ Centrifugal Pump with Water Cooled Bearings and Stuffing Boxes

STANDARD

These 45° diagonally split case pumps have, as standard, 125# A.S.A. Suction Flange and 250# A.S.A. Discharge Flange. Type AJ Pumps are usually Bronze-Fitted but can be furnished All-Iron or Stainless Steel trim for high temperature conditions.

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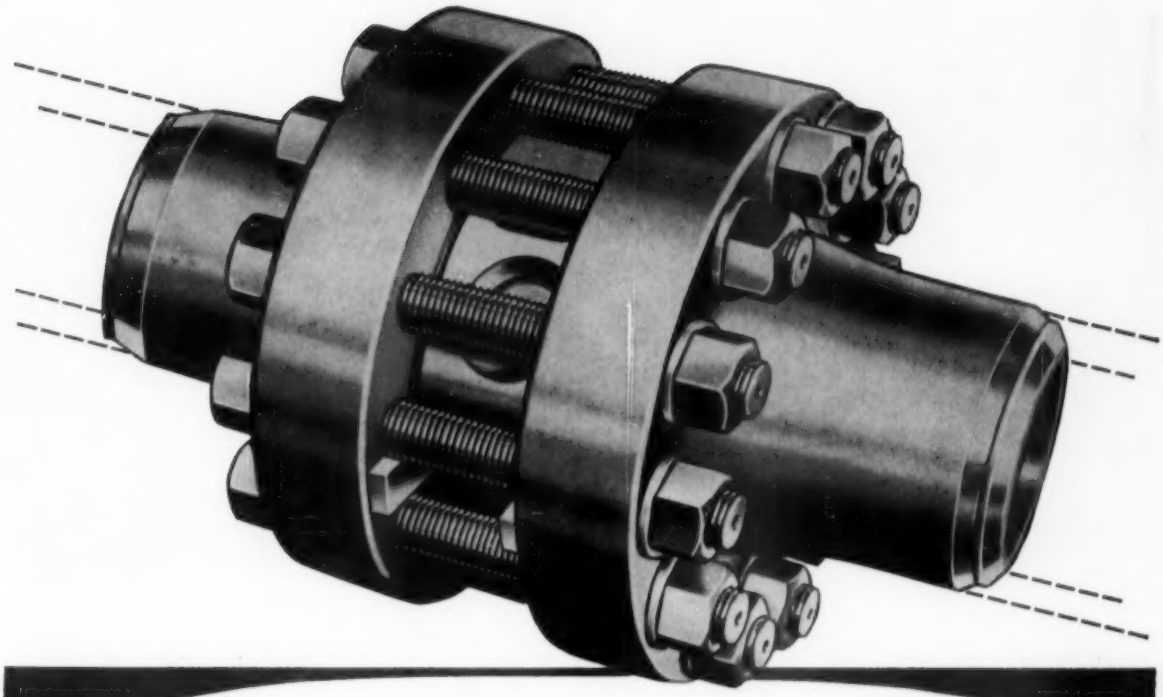

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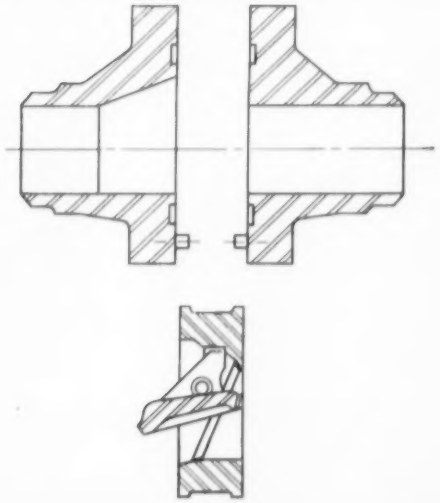

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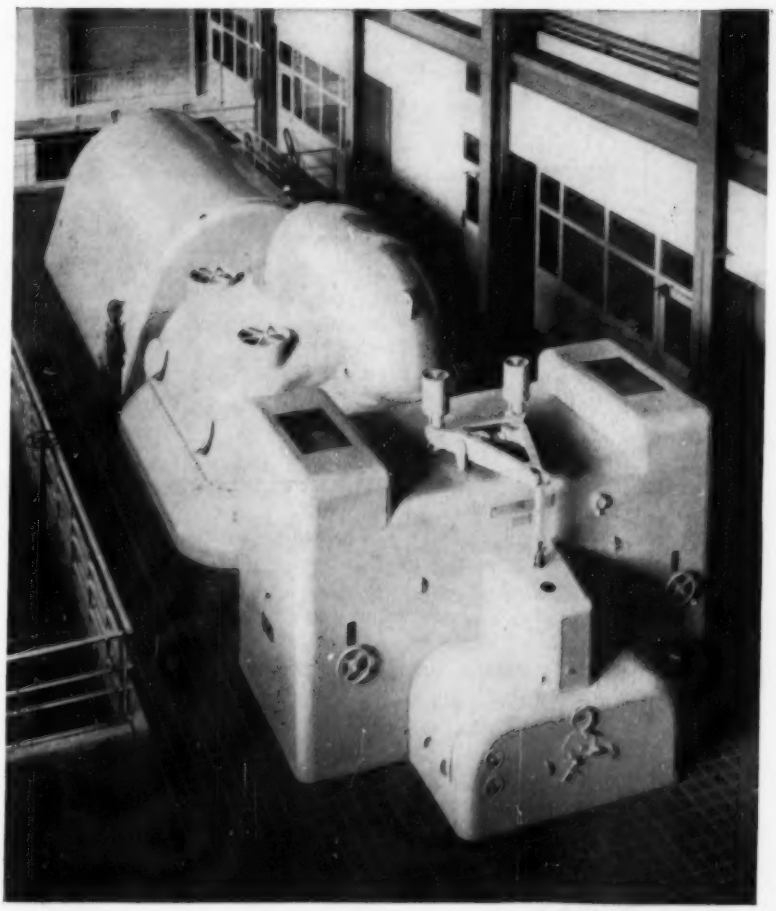

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